POPULAR SCIENCE

FOUNDED MONTHLY 1872

SM

FEBRUARY

25 CENTS

30 CENTS IN CANADA

SPEEDY SKI-CAR
Rides Winter Snows
See Page 61

THE WHEELS START ROLLING

PROBABLY the most remarkable thing about the first Ford car as it bumped over the sill of the little brick shed on Bagley Avenue, Detroit, and out into the dawn of a spring day in 1893, was that its maker had no doubt whatever about its success!

It scared horses. It blocked traffic by attracting large crowds. It became necessary to chain it to a post to keep investigators from starting it down the street.

Since those wheels first started rolling twenty million Fords have taken to the highways of all the world, shaping modern industry and civilization . . . hundreds of thousands of tractors have speeded up industry and smoothed the furrowed ways of the farmer everywhere . . . hundreds of metal planes have scaled above the clouds to the utmost ends of the earth. And no Ford machine is permitted to go forth without the certainty of success attending it!

There is a sound reason for this! When the Ford Motor Company first went into operation to build, deliver and service an automobile for every-day wear and tear, a machine to be admired and depended upon, principles of manufacture were established which made possible the continuous success of this famous car. These principles, briefly stated, in four sentences, are vital in the Ford organization today:

1. No fear of the future and no enslavement to the past.
2. Disregard of competition, because whoever does a thing best will be accepted as the one who ought to do it.
3. Service before profit; though without profit business cannot extend, without adequate service no business can continue to succeed.
4. Manufacturing is the transforming of the best possible materials into the best possible product for the consumer on a basis of fair cost all around.

This is the reason why Ford methods have become a synonym for modern methods and successful manufacture.

FORD MOTOR COMPANY

How to provide a RETIREMENT INCOME for yourself

THIS new Retirement Income Plan makes it possible for you to retire at any age you wish, 55, 60, or 65. You may provide for yourself a monthly income of $100, $200, $300, or more.

Suppose you decide to retire on an income of $200 a month when you are 60. Here is what you get:

1. An income of $200 a month, beginning at age 60 and lasting the rest of your life. You are assured a return of $20,000, and perhaps much more, depending upon how long you live. If you prefer, you may have a cash settlement of $27,000 at age 60 instead of the monthly income.
2. Upon your death from any natural cause before age 60, your wife or any other beneficiary receives a cash payment of $20,000. Or, if preferred, she will receive a monthly income for life.
3. Upon your death from accidental means before age 60, your beneficiary will receive a cash payment of $40,000. Or, if preferred, she will receive a monthly income for life.
4. If serious illness or accident stops your earning power for a certain period before a stated age, you will thereafter receive a monthly income to live on during such disability, even if it lasts for life.

How much does it cost?

A Retirement Income may be paid for in comparatively small monthly installments. The exact amount depends on (1) Your present age (2) The age at which you wish to retire (3) The amount of monthly income you will want.

Say good-by to money worries forever

One of the great advantages of this Plan is that it goes into operation the minute you pay your first small installment. Even though you should become totally disabled, you would not need to worry. Your installments would be paid by us out of a special reserve fund.

Get this Free Book

The Phoenix Mutual Company is one of the oldest, most conservative institutions in this country. It was founded in 1851, and has been helping men and women to end money worries for over three quarters of a century.

An interesting 24-page book called "The Phoenix Mutual Retirement Income Plan," explains how this plan works. Send for your copy today. There is no cost. There is no obligation.

PHOENIX MUTUAL LIFE INSURANCE CO.
665 Elm St., Hartford, Conn.

Send me by mail, without obligation, your new book, "The Phoenix Mutual Retirement Income Plan."

Name_____

Date of Birth_____

Business Address_____

Home Address_____

PHOENIX MUTUAL LIFE INSURANCE COMPANY

Home Office: Hartford, Conn. **First Policy issued 1851**

25 Cents a Copy
$2.50 a Year

POPULAR SCIENCE MONTHLY

381 Fourth Avenue
New York, N. Y.

Table of Contents for February, 1932

LEADING ARTICLES

FEATURES AND DEPARTMENTS

ASTRONOMY

AUTOMOBILES

AVIATION

MODELS

NEW PROCESSES AND INVENTIONS

February, 1932, Vol. 120, No. 2. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1932, by the Popular Science Publishing Co., Inc. Single copy, 25 cents (30 cents in Canada). Nine months subscription in U. S., $2. Yearly subscriptions to United States and its possessions, $2.50; foreign countries, including Canada, $3. The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. In presenting numerous stories of new products of applied science, **Popular Science Monthly** does not underwrite the business methods of the individuals or concerns producing them. The use of **Popular Science Monthly** articles for stock-selling schemes is never authorized. A. L. Cole, President and Treasurer; R. C. Wilson, Vice President; John Nichols, Vice-President; F. W. Briggs, Secretary.

Popular Science Monthly for February, 1932

PHOTOGRAPHY

RADIO

UNUSUAL FACTS AND IDEAS

FOR THE HOME OWNER

WOODWORKING

IDEAS FOR THE HANDY MAN

HINTS FOR THE MECHANIC

A Pay Reduction

That Goes in the Bank for You

By LEON MEADOW, *Financial Editor*

"I SUPPOSE I shouldn't grumble about Christmas presents and all that," said George Barton to his neighbor, Edgar Ross, as they rode home on the commuters' special one evening shortly after Christmas. "Of course, it's a little strain on my pocket every year—but this year—after almost two years of depression—it's been harder than ever. In fact, I don't see how I'm ever going to meet my obligations—and get the family ship moving on an even keel once more."

"Have you tried budgeting?" his friend asked.

Barton laughed. "It's been all I could do to keep things going these last two years—no less wasting time on ledger books and carfare memoranda."

"Have it your own way," Ross replied, "but I'm still a firm believer in those old proverbs about ill winds and silver linings. I'll admit it took a depression to do it, but I've finally been taught the wisdom of knowing where my money goes, and of keeping a firm hand on the financial reins by means of a sensible budget for the household firm of Ross & Family, Inc."

"What do you mean by a sensible budget?" interrupted Barton. "There's no such thing. A lot of them sound all right—but none of them ever really works out in practice. When you get through at the end of the year, you may know where every penny went to—but that doesn't mean you've boosted your savings account, or cut down on your expenses. It all reduced itself to petty bookkeeping and scrap paper for the baby!"

"Is that so!" exclaimed Ross, heatedly. "I can see that you have the average man's conception of what a budget is. Well, it's about time someone knocked the props from under those false ideas of yours—and set you on the right track. And I might as well be the one to do it."

"Go right ahead, old man. I'm a good listener, if nothing else."

"WELL, to begin with," said Ross, "like the average man, you scoff at the sound of the word 'budget'. You say it isn't practical—won't work out. Yet, if I should ask you whether it is possible to build a good house without the direction of blueprints, you would say I'm crazy—and that it's ridiculous to think of putting up a house that way.

"Now tell me—is there any vast difference, in principle, between building your financial life with a plan and building a house from blueprints? As a practical man, you know that a house constructed without the use of blueprints will turn out to be a pretty 'lop-sided' affair, with poorly laid-out rooms, uneven floors, and all sorts of misfits. Of course, you can live without a budget—but generally speaking it will be in much the same topsy-turvy, ill-proportioned way you would put up a house without working plans of some specific description.

"I'm driving at this, George," Ross continued, ". . . a house is a better planned, more livable shelter by virtue of the directions which were followed in its erection. And, by the same token, the daily business of living becomes a more comfortable procedure—a more balanced, rational and secure affair by virtue of the budget or financial plan you follow in its execution. Am I right or wrong?"

"Right," replied George Barton, "and I didn't want to say anything that would lead you to believe I thought otherwise. My quarrel isn't with the budget itself. It's a fine thing. But there must be something radically wrong with it in practice, because so many people undertake the task of living by a budget, and then so soon discard it—or, if they do follow it out, they don't seem to be measurably better for having done so. Show me why that is—and then I'll believe more wholeheartedly in your budget idea."

"YOUR point is well taken," answered Ross. "Many families go on the budget system by buying three or four fancy notebooks, a dozen pencils, and plenty of erasers. They put down the total amount of the family's income on one side of the page—and then proceed to fill the rest of the book or books with daily carfares and ice cream sodas and whatnots. When the end of the year comes around—if the plan lasts that long—they add up all the expenditures, praying at the same time that the whole mess balances. In other words, their main concern is to account for every penny spent—and to hold that account within their total income.

"And while such a purpose is admirable in itself, the results will not prove as worthwhile as they could under the proper type of budget. As I see it, the entire purpose of budgeting family expenditures is to do so with a very definite goal, other than mere account-keeping, in view. Here again, comparison with the blueprint and house argument offers itself. For the whole idea in using blueprints to build a house is to have the dwelling in its completed form represent exactly what it was originally planned to look like, down to the last detail. Then you know that where the blueprint calls for a room of 'such and such' a size, the finished house will have that room, that size.

"In other words, a blueprint is the means to an end—and that's exactly what a budget is. And the end, in the case of a budget, should be a definite, pre-arranged amount of *(Continued on page 5)*

A PAY REDUCTION THAT GOES IN THE BANK FOR YOU

(Continued from page 4)

savings for the year. Budgeting for the sake of a budget isn't enough. You've got to make up your mind to save a certain amount—and then call in a budget to help you carry out your project. Suppose, for the sake of illustration, your income for the coming year will be $5,000. Now, instead of drawing up a budget whose purpose is to keep your expenditures for the year within that figure, and to show you exactly how you can do it, down to every last nickel and penny—instead of setting out that way, I suggest that you begin with these points in mind:

"Hard times have struck home. Everywhere else, all along the line, pay reductions have been put into effect. The household firm of Barton & Company is hit also, as are so many other businesses, and forced to apply a 10% pay reduction to its members' incomes. The $5,000 suddenly shrinks to $4,500. But now the story changes a bit. This pay reduction is different from the usual kind. For, while there has been a 10% reduction in the weekly income, that loss will actually be credited to your savings bank account each week—so that, at the end of the year, you will have an additional $500. in the bank to balance the 10% loss in income.

"In short, you are going to deposit a little less than $10. a week in your savings bank, and then forget about it by assuming that this shortage in your income is due to a 10% pay reduction. Bear this in mind and count on your income for $4,500 only. Now, take this reduced sum and you are ready to start talking about budgets and plays for 1932. Lay out your budget so as to make $4,500 cover the expenses that you formerly figured would have to be taken care of with $5,000. Hammer into yourself the idea that you must live within that $4,500 and you'll find—once you've set this definite goal—that it can be done just as well on $4,500 as it can be on $5,000.

"THESE figures may not fit your case, but the idea is the same with any set-up you make. Instead of merely having a notebook filled with a lot of figures, you will have accomplished one definite and big thing. You will have saved money—and that should be the real purpose of any sensible budget. Now try and tell me that's a waste of time!"

"I'll try nothing of the sort, Ed," Barton said in a rather surprised voice. "I'm with you 100% on that idea. You know I've never looked at it in that light. But now that I look at it that way, I really see the value of a budget—and I think I'll include your plan in my 'A-1' New Year's Resolutions."

"What do you mean—'A-1'?"

George chuckled. "You know," he replied, "we all make a number of them—and so do I. But the ones I call 'A-1' are the ones I really mean to keep. The others are generally forgotten in about a week."

(Continued on page 6)

A PAY REDUCTION THAT GOES IN THE BANK FOR YOU

(Continued from page 5)

"It certainly won't do you any harm to stick by this one, George. And now I'll put you straight on another popular fallacy. The actual process of keeping an annual budget is not the tedious, paper-consuming job you think it is. At least, I don't find it so."

"How does yours operate, Ed?"

"Very simply. My first step is to set aside, figuratively speaking, the annual amount of savings to be made. Actually, I deposit enough money each week to take care of this for the year. With that out of the way, I then divide my budget into two classes—one, *Fixed Charges*, and the other, *Fluctuating Expenses*. The first consists of rent, taxes, insurance premiums, etc. The second consists of medical bills, food, clothing, amusements, etc.

"I TACKLE my fixed charges first by making a memorandum on one page of the amount I have to put in the bank every month to pay them, when the bills come in. This eliminates all further bookkeeping on this account. My check book stubs are all the records I need. Then I subtract the fixed charges from my net income—that is, my total income less the savings deposit I mentioned before. The remainder, then, must be enough to cover all the fluctuating charges which Ross & Family will encounter in the course of a year. Or perhaps I'd be more correct in putting it the other way. The fluctuating charges must not exceed the remaining income. Incidentally, these items require a memorandum page of their own.

"So far, you see, there's been little or no bookkeeping. As a matter of fact, the entire plan calls for but one bit of pencil sharpening and account-keeping—and that will consist of keeping track of the money spent on fluctuating charges. Both you and Helen will have to make it your business to keep these expenses within the amount set aside for them."

"That seems to be the hitch in every family budget system," put in George Barton.

"If you think of it as a hitch," Ross answered, "you'll probably end up by abandoning the plan before long. The best way to conquer this hurdle is by taking as your first New Year's Resolution this thought: *I will face* the *facts*—and to stick by that resolution.

"TO maintain a successful budget, be it for the financing of the home, the operation of a business or the management of a government, the facts must be faced. In a broad sense, the foundation of any plan is only as strong as the knowledge of the facts upon which that plan depends. Facing facts requires courage, George. Usually, we are afraid to face them—because we are afraid to learn what they have to say—or, because by facing them, where a budget plan is considered, we shall be forced by real common sense to *(Continued on page 7)*

A PAY REDUCTION THAT GOES IN THE BANK FOR YOU

(Continued from page 6)

change our way of living."

George Barton did not reply immediately. That last statement of Ed's was sinking in . . . striking home. Slowly he nodded his head, and then turned to his friend. "You put your finger on the sore spot that time, Ed," he answered, "and I, for one, can't dodge the truth of a statement like that. It's sound reasoning, and I'm thoroughly convinced of its value. Let me tell you something—Barton & Family are going on the Ross Budget Plan in 1932 and they're going to see it through successfully or 'bust' in the attempt! The first step toward its execution will be an executive conference to be called to order tonight," said George with a smile, as both men got up to leave the train.

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

Your Income and Your Life Insurance is the name of a brief booklet scientifically answering the question "How much life insurance does a man really need?" Provident Mutual Life Insurance Company of Philadelphia, Pennsylvania, will mail a complimentary copy upon request.

Before 65 and After explains the full details of a Retirement Income, with full Life Insurance, Disability and Double Accident benefits. Sent on request by The Equitable Life Assurance Society, 393 Seventh Avenue, New York City.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate Plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

Booklets, Samples, Information, Available To Popular Science Readers

By referring to the advertisements on the pages indicated below, you can solve a great many problems. Most of the advertisers in Popular Science Monthly offer valuable catalogues of tools, or booklets of information and instruction. Others will send you samples of products ranging all the way from shaving cream, to glue, and tobacco. We recommend these advertisers to you. There is so much real information in their announcements in this magazine that readers of Popular Science Monthly will find them not only interesting but decidedly helpful as an index of the most modern and practical devices and developments.

Popular Science GUARANTEE

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use.

Tools, Radio Apparatus, Oil Burners and Refrigerators advertised in POPULAR SCIENCE MONTHLY have been tested or investigated by the Popular Science Institute of Standards and each advertisement carries the insignia indicating approval.

However, other products advertised in the magazine not subject to test carry the same guarantee to readers as products tested.

THE PUBLISHERS

"I didn't get the job"

HE'D counted on landing the job—but he missed out. Again he'll have to "stall" the landlord, the grocer and all the rest. One thing stood between him and a weekly pay check. His wife is somewhat reluctant to tell him. He doesn't realize that a fresh, close shave is important in getting and holding a job.

• • •

Far too many men *shave,* without being *clean* shaven. The blade you choose and the way you use it make the difference. Of course you can't shave your way to independence, but a fresh, immaculate appearance will help. The slightest growth of stubble is a handicap.

Today Gillette offers a new blade that makes close and frequent shaving easy and comfortable. It never roughens or irritates tender skin. Stubborn beard is sheared away quickly and smoothly. Try the new Gillette on our guarantee. You risk nothing. Buy a package and use two blades. If every shave isn't clean and pleasant—return the package to your dealer and he'll refund the entire purchase price.

Gillette

RAZORS — Gillette — BLADES

What It Costs to Operate a RADIO

The cost of radio entertainment is very low and affords much pleasure to millions

By
F. G. PRYOR
Secretary, Popular Science Institute

CERTAIN things, like buying a new set of tubes or an occasional need for servicing, have a way of looming up in the minds of radio owners and giving the false idea that a good deal is being spent for radio entertainment. As a matter of fact, when you figure out all the various costs incidental to radio operation on a yearly basis, it is apparent that amusement comes far more cheaply by radio than by most other means.

In so far as power supply goes, one cent an hour at the very outside is all it costs to operate a radio receiver. More generally, one-half cent is all that is spent for electricity, the average power rate today being more nearly six cents per kilowatt hour that the ten-cent rate on which the former figure is based. The average set, which we will consider one of nine tubes, draws from eighty to one hundred watts per hour, while small sets go as low as fifty watts. Ten dollars a year is a fair amount to count for current.

So much for power; we shall now consider the matter of tubes. The average set of tubes needs replacement about once a year, sometimes less and sometimes more frequently, depending largely on how much the set is used. Tubes produced today are fairly consistent in giving 1,000 hours of service and, in most households, 1,000 hours a year or three hours a day is about all that a set is used. The retail price of a set of tubes for most modern electric receivers comes to approximately $15, so this amount can be assumed as the average yearly tube replacement cost.

Depreciation of the set should, of course, be counted if we are to get an accurate picture of the cost of operating a radio receiver. It is rather hard to figure this since there are two ways of looking at the matter of set depreciation. From the standpoint of turn-in value, a set depreciates to a very large extent just as soon as it is installed and first used in the home. And, from this angle, it depreciates about seventy-five percent by the time the next models are announced. However, considering the matter from the standpoint of the receiver's period of usefulness, about twenty-five percent might be charged off each year for depreciation. Modern sets are good for four years of service at the very least, and for a great deal longer if you do not place great importance on having a set that has all the very latest features and refinements. A good set rarely ever *wears out*.

ALLOWING about $100 as the initial price of the receiver, the yearly cost of operating such a set would be something like this:

Depreciation on set	25	dollars
Replacement of tubes	15	"
Power consumption	10	"
Total annual cost	50	"

Even with all these generous allowances for the various items, it brings the daily cost of radio amusement to approximately thirteen cents a day or four cents an hour, with a possible slight addition if there is any servicing required. If you use your set for ten years without much repair cost, that would lower hourly operating cost to three cents.

In basing our figures for radio operating costs, we have purposely overlooked the new midget type of receiver which is being favored so much at this time. There is no such thing as an average midget set, there being two very distinct types of midget receivers. Those in the very low price class (about $3? or thereabouts) form the largest group of midgets, and then there is the other distinct group of midgets much higher in price (approximately $69). The cost of power for operating the lower priced midgets is about one-half that for an average large set, their current consumption running from forty to fifty watts per hour. Most of these midgets have five tubes, and that means a cut of almost one-half, also, in tube replacement per year.

THE difference between the more expensive midgets and the larger sets is not so much in operating as in initial cost, as they consume almost as much power and have nearly as many tubes. However, these larger midgets as a rule are more serviceably built and there is less likelihood of any repair cost.

While electric sets today take about as much power to operate as the first electric sets put out, tube replacement cost has gone down appreciably due to improvement in tube quality, and also design has become more standardized, lowering the rate of depreciation.

Considering both the lowered operating and also initial cost for radio sets, the present is an excellent time for anyone without a modern receiver to make a radio investment.

HAVE SUNSHINE all winter long, AT LITTLE COST

Ultra-Violet radiation in the bathroom

THE MAZDA Sunlight Lamp (Type S-2) brings the benefits of mild ultra-violet radiation equivalent to the best midday midsummer sunshine into the home, at small cost.

Inexpensive wall or ceiling fixtures required for the operation of this lamp enable you to bask in ultra-violet rays while you bathe. Men can have the benefits of ultra-violet while shaving.

Floor and table lamps constructed especially for the use of the MAZDA Sunlight Lamp (Type S-2) in living-rooms, bedrooms, and solariums, permit you to enjoy ultra-violet radiation while you indulge in bridge, or read or rest. Special fixtures are also available for use in offices, gymnasiums, indoor playgrounds, and at swimming pools.

For full information use the coupon below, or address any of the manufacturers listed here.

The New Mazda Sunlight Lamp (Type S-2)

This lamp can be operated at an average cost of less than 1½¢ per hour. It operates only on A. C. and *in fixtures specially designed for its use.* *Note:* The MAZDA Sunlight Lamp (Type S-1) is also available in new fixtures, and for renewal purposes.

BEARDSLEE CHANDELIER MANUFACTURING CO.,
216 South Jefferson St., Chicago, Illinois

BENJAMIN ELECTRIC MFG. CO.,
Des Plaines, Illinois

BRADY MANUFACTURING COMPANY,
565 East Larned St., Detroit, Mich.

CURTIS LIGHTING, INCORPORATED,
1123 West Jackson Blvd., Chicago, Illinois

DOMINION ELECTRICAL MFG. CO.,
712 Ontario Avenue, W., Minneapolis, Minn.

THE FRINK CORPORATION,
23-10 Bridge Plaza South, L. I. C., N. Y.

GENERAL ELECTRIC COMPANY,
Merchandise Department, Bridgeport, Conn.

THE EDWIN F. GUTH COMPANY,
Jefferson & Washington Aves., St. Louis, Mo.

HEALTHMASTER SUN RAY LAMP DIVISION, LIBERTY ELECTRIC CO.,
50 West North Street, Indianapolis, Ind.

HOLOPHANE COMPANY, INC.,
342 Madison Avenue, New York, N. Y.

THE KAYLINE COMPANY,
600 Huron Road, Cleveland, Ohio

LIGHTOLIER COMPANY,
569-575 Broadway, New York, N. Y.

LUMINATOR, INC.,
851 Washington Blvd., Chicago, Ill.

THE MILLER COMPANY, Meriden, Conn.

MOE-BRIDGES COMPANY,
220 North Broadway, Milwaukee, Wis.

S. ROBERT SCHWARTZ & BRO.,
160 Varick Street, New York, N. Y.

THE F. W. WAKEFIELD BRASS CO.,
Vermilion, Ohio

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.,
Edgewater Park, Cleveland, Ohio

TESTED AND APPROVED

A GUARANTEE OF RELIABILITY

This emblem is a guarantee that the fixture to which it is attached has been tested and approved for illumination and ultra-violet effectiveness when used with the MAZDA Sunlight Lamp (Type S-2). Purchasers should look for this emblem when buying fixtures for the MAZDA Sunlight Lamp.

Above are shown some of the special fixtures required for the use of the new MAZDA Sunlight Lamp (Type S-2)

MAIL COUPON FOR FREE BOOKLET

"Ultra-Violet for Everyone" describes the MAZDA Sunlight Lamps (Type S-1 and Type S-2) and illustrates some of the new inexpensive fixtures now available.

You may obtain this booklet by mailing the coupon to Ultra-Violet, 2144 Keith Building, Cleveland, Ohio. Any manufacturer listed here will gladly send you detailed information regarding the fixtures made by him.

ULTRA-VIOLET, 2144 Keith Bldg., Cleveland, Ohio
Kindly send me, without charge, a copy of "Ultra-Violet for Everyone."
(Please print name and address legibly.)

Name.....

Street and Number.....

City.....*State*.....

Our Readers Say

Here's Perpetual Motion but How Does It Work?

Is PERPETUAL motion possible? Yes. That is a bold statement, but I am able to prove it. I know that some of the wisest men who ever lived have worried their brains about it during the past 3,000 years, yet were never able to make it work. I am also aware of the fact that present-day science claims it to be absolutely impossible. But I have made a machine that actually runs without any apparent source of power. Since you are publishing a scientific magazine, which I enjoy reading, I thought you would like to know about this "eighth wonder of the world," perpetual motion, strange as it may seem.—R.R.B., Durham, Calif.

He Deserves It, but That Would Make a Mighty Book

IN MEMORY of the great inventor, Thomas A. Edison, I wish you would take the next six issues of your magazine and devote the entire book to a publication of a complete life history of this famous man. These could be bound in one book and I am sure nearly everyone would like a set. Nothing we can do will pay him the honor he deserves. Perhaps you have a better plan. I hope so. I have over one hundred copies of your magazine and have never yet been disappointed. Yours for hundreds more.—E.A.B., Moorhead, Minn.

Don't File Back Numbers: Keep Them with Your Files

I THINK your magazine is great. It makes me laugh when I read the way some readers would have your magazine written. I can't help but wonder what some of these fellows look like, who are constantly knocking the carpentry section. I agree with L.S.Y. of Berkeley, Calif., about the carpentry section, but I don't agree with his keeping his old copies of P.S.M. in the attic. I keep mine in my workshop for reference.—B.A.B., Kansas City, Mo.

Flying Must Be Great but the Motorcycle Is Cheaper

SOME time ago you asked readers if they thought too many aviation articles were appearing in the magazine. For my part, I can never read enough about aviation, but am one of those unfortunates who is financially unable to fly. I take to the next best sport, which is motorcycling, and wish you would print more articles on that subject, particularly the need of more garages with machinists who understand the motorcycle and which keep a few simple screws to replace those that vibrate loose and cause trouble. May I suggest that you try a motorcycle page? It may prove quite popular.—R.A., Nashville, Tenn.

"New York's Real Underworld" Wins Warmest Admiration

HAVE just finished reading your article, "Exploring New York's Real Underworld." May I say it is one of the most interesting I have ever read or ever hope to read. Talk about giving the lowdown on what's under the pavements of New York's streets! Say, that story was just the thing! Interesting and more than informative. Now all I have to do is reread it once or twice and I shall be able to give some real information to visiting friends from out of town. Let's have more of 'em. If that's not possible, let's have stories about other large towns in the United States, giving some real dope about what's what and why under their streets. For real live interesting stories about everything in general give me POPULAR SCIENCE MONTHLY. I am a seafaring man and have bought magazines in many different parts of the world, but the best of 'em comes a pretty poor second to POPULAR SCIENCE MONTHLY. 'At's the king-pin of the whole lot.—L.T.B., New York, N. Y.

Maybe It Would Go to Pieces Everywhere at Once

I SEE by a recent issue of POPULAR SCIENCE MONTHLY that B.C., Gloversville, N. Y., is puzzled by a chain problem. He is of the opinion that if a chain were made with all the links of uniform strength it would not break no matter what strain was put upon it. He bases his opinion on the fact that a chain is as strong as its weakest link, but as there is no weak link it would be impossible to break it. Suppose that a weight is suspended from a chain in which all the links are of uniform strength. Now if this weight is just sufficient to break a single link it is only natural that there is enough strain present to break the chain, and it is my opinion that the top link will be the one to snap. The reason for this is that it receives more strain than any other link in the chain, for not only does it support the weight but it must also support the rest of the chain. As for a chain that is horizontal, things are a bit more complicated. In such a case both end links are under equal strain, and it would be difficult to tell which one would part first. Probably both links would break at the same time.—F. R., New Bedford, Mass.

Here's a Reader Asking for Fiction in Your Magazine

I HAVE been reading POPULAR SCIENCE MONTHLY since 1926. There was a story, then, about some fellows who were lost on an island and built a boat and made all their own tools including a lathe and smelter for constructing an engine to drive the boat. I think the story was a little far-fetched, but it made darn good reading anyway. Why don't you have some more like that? Some of these guys that write for "Our Readers Say" page give me a pain in the neck. Anyone would think they wanted the magazine published for them alone.—C.B.S., Independence, Kan.

Take a Look at This, You Knockers, and See How You Like It

LISTEN, all you guys with your mouths open all the time! You're continually hollering about this magazine not printing enough of this and that "to suit me." Each of you wants a whole book on the subject that you like. What do you want in one magazine for two bits? An education in all the sciences? A lot of you are squawking about the fact that there are too many articles in this magazine dealing with aviation. Why are they there? Aviation has a broad field in which work may be done, and there are people who are doing this work. That's why they have articles in this magazine about it. You find out what people are doing along this line. Instead of doing so much snorting around about there not being enough of "my science" in this magazine, why don't you get busy and do something along your particular line of interest that will be cause enough for this magazine to say something about it? If there are no developments in the science you're interested in, how do you expect this magazine to treat it?—R.P., Staples, Minn.

Make It Snappy Now: How High Is This Plane?

I ENJOY everything in your magazine, but what interests me most is your "Our Readers Say" column, and everything on woodworking and metal novelties. Will your readers solve this problem: How high must a plane be to be seen twenty-five miles away on ground level?—M.O., San Francisco, Calif.

Shortening Ford's Wheelbase One of the Simplest of Things

IN A recent issue of POPULAR SCIENCE MONTHLY, a contributor to "Our Readers Say" wanted to know how to shorten the wheelbase of a Model T Ford for racing and somersaulting purposes. I am an expert on the Ford models from A to T, and I know that the most efficacious method for accomplishing this trick is as follows: Place the Ford in front of a thick wall, get a five-ton truck going at fifty miles an hour, and bang into the

Our New HOMECRAFT GUILD

Acclaimed by Readers

IT WAS a little incident—a straw in the wind—that gave the editors the first indication of the tremendous success of our new service organization, the Popular Science Homecraft Guild, announced in the January number and explained again in detail on page 78 of this issue. The Guild was formed to encourage more men to take up the home workshop hobby and particularly to make it easy for them to get started—so easy, inexpensive, pleasurable, and profitable, in fact, that they would be certain to continue from one project to another until they were full-fledged amateur mechanics with well-equipped home workshops. As the first step in this direction—and the greatest step ever taken by a magazine to promote interest in home craftsmanship—a kit of parts was offered for building a beautiful butterfly table.

Fully a week before the January issue with the announcement reached the newsstands, an order was received for one of the kits. This was so astonishing that an investigation was made, and it was discovered that an employee of the printing plant had read the article before publication and been so impressed that he sent his order in right away.

As soon as the issue was actually on sale, orders and letters were received by the hundreds, far in excess of even the most optimistic predictions.

"I have just been looking through your latest issue," one reader wrote, "and am quite interested in your Homecraft Guild. I think it a splendid idea and it certainly should be well taken up. What struck me especially was the price of the butterfly table. I have always been interested in making things of the type you publish, but when it comes to buying the more expensive woods to which there is so much waste when one has to cut it oneself, it soon mounts up to a rather prohibitive price."

"I am greatly pleased with this innovation of POPULAR SCIENCE MONTHLY," said another reader, "and sincerely hope its reception by your readers will more than justify the undertaking."

These are typical of all. Some letters suggested pieces of furniture to be included in the construction kits the Guild is preparing. These suggestions are being tabulated and will be utilized in expanding the Guild's work. The pieces to follow in the immediate future probably will be a coffee stand, a sewing cabinet, a chest, and a magazine rack.

We have always described our Home Workshop Department as a clearing house for the ideas of men who like to work with tools. The Guild is an extension of this same idea, and therefore we welcome the suggestions of readers for extending its activities and making it more helpful.

rear of the Ford. This will reduce the wheelbase to exactly three inches. If you think the wall may not be solid enough, use a young mountain, properly braced.—M.I., Detroit, Mich.

Speaking of Woozy, Go Nuts Over This One!

I SHOULD like to ask Mr. B.C. of Gloversville, N. Y., who had "Just a Little Problem but It's Got Him Woozy" in the column of what "Our Readers Say," if it was the load of straw that broke the camel's back or was it the last straw piled on the load? If the last straw had not been piled on the load, the camel's back would not have been broken; and the last straw could hardly break a camel's back, though a load of straw might. But the load could not break the camel's back without the last straw. Kindly tell me which it was that broke the camel's back, the load of straw or the last straw.—H.H., Raytown, Mo.

Don't You Worry; He'll Keep It Up, All Right

LET me congratulate POPULAR SCIENCE MONTHLY on its cover drawings. They are better, more interesting, and truer to life than those appearing on any other magazine in the scientific field. Tell your artist to keep up the good work. Your article on the falsehood of astrology was so convincing that I clipped it out and sent it to one of the astrologers who broadcast on the air. Let's have more of such articles.—H.H., Brooklyn, N. Y.

Maybe You Scientists Will Behave Yourselves After This

JESSE F. GELDERS' article on astrology in POPULAR SCIENCE MONTHLY was bunk, to express it mildly. I don't deny that there are charlatans among the astrologers, but if you look for them you find them in every other walk of life. Who are these "recognized scientists"? Aren't they full of theories, assumptions, and hypotheses themselves? And they expect us to believe every word they say!—F.P., Los Angeles, Calif.

Some Folks Think It Makes a Lot of Difference

IF WE are, as the scientists say, monkeys or their descendants, what will the end be? Say, Mr. Editor, what difference does it make? If the evolution theory is true, wailing and gnashing of teeth can't make it false. If it is not true, then all the scientific teaching, theories, and discoveries can't make it true. So why worry? We are here. We are what we are, and all the arguing and teaching can't change it. What difference does it make whether creation took a million years or was instantaneous? We were made from the dust of the earth. So are all animals, and if man was made from an animal, it was from the dust of the earth. God could have made man out of a monkey or an opossum just as easily as out of a pile of dirt. If we are human, then we are. If we are descendants of animals, we are what we are; worrying won't change it.—F.C.C., Flint, Texas.

Simple Little Trick to Make Hard Things Easy

PROBLEMS apparently quite difficult can often be made very simple by using a graphic drawing. Such was the problem recently published by POPULAR SCIENCE MONTHLY as follows: "A man is now twice as old as his wife was when he was as old as she is now. When she becomes as old as he is now, the sum of their ages will equal 100. What are their respective ages?" Draw six horizontal lines, parallel and equidistant apart, with a perpendicular end line. From where this perpendicular line cuts horizontal lines Nos. 3 and 4, draw two parallel slanting lines (any angle) cutting the upper horizontals. The upper slant represents the man's varying ages, and the lower one, the wife's. The perpendicular distance between these slants is constant. The distance between horizontals Nos. 1 and 5, plus distance between Nos. 1 and 6, equals 100. The man's age is now 44 and 4/9 years, and his wife's age is now 33 and 3/9 years.—O.R.A.M., Los Angeles, Calif.

Better Hurry Through Your Call for Prof. Einstein

THE following problem has been exercising my mind to a considerable extent, and I would like you to submit it to your mathematically-minded readers. Given two single-cylinder engines consisting of a piston, connecting rod, and crank. Assume that the big and little end bearings of the crank are perfect (i.e., no loss of motion). If the one engine is turning at one revolution per second and the other at one hundred revolutions per second (or any other faster speed), is the period of time for which the piston is stationary at the top (or bottom) of the stroke shorter for the faster engine? My own opinion is that the period of time is the same for both engines. I will try to explain why: The piston is at the top of the stroke when the center of the big end bearing coincides with a line drawn axially through the center of the cylinder, small end bearing, and crank center. That is, there is only one point where the piston is at the top dead center, where the center of the crank is; on either side of this point the piston is either ascending or descending. Now, geometrically, a *point* has position but no magnitude, therefore the period of time taken for a moving point to pass a stationary point is *infinitely small*, whether the moving point is traveling fast or slowly. But two periods of time both infinitely small must be the same, for if either one were longer than the other then it would not be infinitely small. The question almost arises as to whether the piston stops at *all*, and yet we know that it must, because a body traveling in a straight line *must* stop before it can reverse its motion and travel in the opposite direction on the same straight line. The more I think of it, the more I wonder whether the above solution is right or wrong—perhaps Einstein can give a definite answer.—E.W.D., Adelaide, Australia.

Length of Human Life Not Determined by Speed of Earth

I THINK J.A.G., Scranton, Pa., is off his base. I don't believe anyone knows whether or not the earth is slowing down. Some writers claim it is and others deny this. I don't think its speed has anything to do with the actual length of human life. If it were possible to visit another planet and stay away a month, the traveler would be a month older when he returned. In other words, if we now live sixty years, we would live double that number of years if the earth made its revolution around the sun in six months.—C.C., Flint, Texas.

Sense of Smell Depends on Chemical Action—or Something

FOR the last few years I have been looking forward to a scientific explanation of the sense of smell. During this period I have nursed several different theories but none of them seems as plausible as the one in which I now believe. My theory says that it is an electronic action resulting from a chemical action taking place either in the nasal tract or in the lungs. It is well known that almost all compounds give off a gas that is identical in atomic structure to the compound itself. This gas is a very weak solution, although not too weak to be detected by the sense of smell via the chemical action route. A few facts to sustain this theory are: First, when heating a substance causes increased molecular action, the smell is more readily noted. Second, when no air is taken into the nose there is no sensation of smell, thus proving that there must be an actual quantity of gas taken into the nasal tract in order to produce the sensation of smell. Third, when a person has a cold he loses his sense of smell. This may be accounted for by the fact that the chemically active member in the nasal tract is covered with mucus, thus allowing only the stronger (if any at all) smells to be recorded.—H.E.P., Akron, Ohio.

Not a Copy Gets Past This Canadian Doctor

I HAVE taken your magazine now for over ten years. During this time, I am sure I have not missed a single copy. I have found it interesting and instructive. One really feels that he knows personally the writers by following their articles.—Dr. F.D.F., Campbellford, Can.

Praise from the Man Who Arranged the Show

PERMIT me to express my hearty thanks to you for the article "Electric Key Fires Old Volcano" and the realistic cover picture in colors on your November number. Would also like to say that your reporter went to a great deal of trouble climbing the steep trail of the mountain several times, making the pictures right in the crater. Your entire treatment of the subject is the best of any article the writer has seen.—F.G.H., Los Gatos, Calif.

Leaving It Hidden Would Save a Lot of Work

IN THE northern part of this province, men at great pains extract gold from the depths of the earth in the rock where it has been jealously hidden and guarded by Nature. Eventually the metal finds its way to New York where, with great pains, it is again hidden in the depths of the rock, zealously guarded by every device known to man. (See POPULAR SCIENCE MONTHLY, Nov., page 137.) Ain't progress wonderful?—W.J.L., Wiarton, Can.

Veteran of a MILLION RAILWAY MILES

R. I. Nesmith

Railroad Coach No. 4925. It was in one of the journals of this coach that an SKF Spherical Journal Bearing covered a million miles in nine years of service. Couch and bearing are still doing duty.

2817

SKF Bearing on Railroad Coach No. 4925 covers a million miles without adjustment . . . without showing wear!

What other make of bearing in all the world can even approximate such a record as this? What other make of bearing has stood up in a railway journal for nine long years or covered a million miles without adjustment . . . without showing wear?

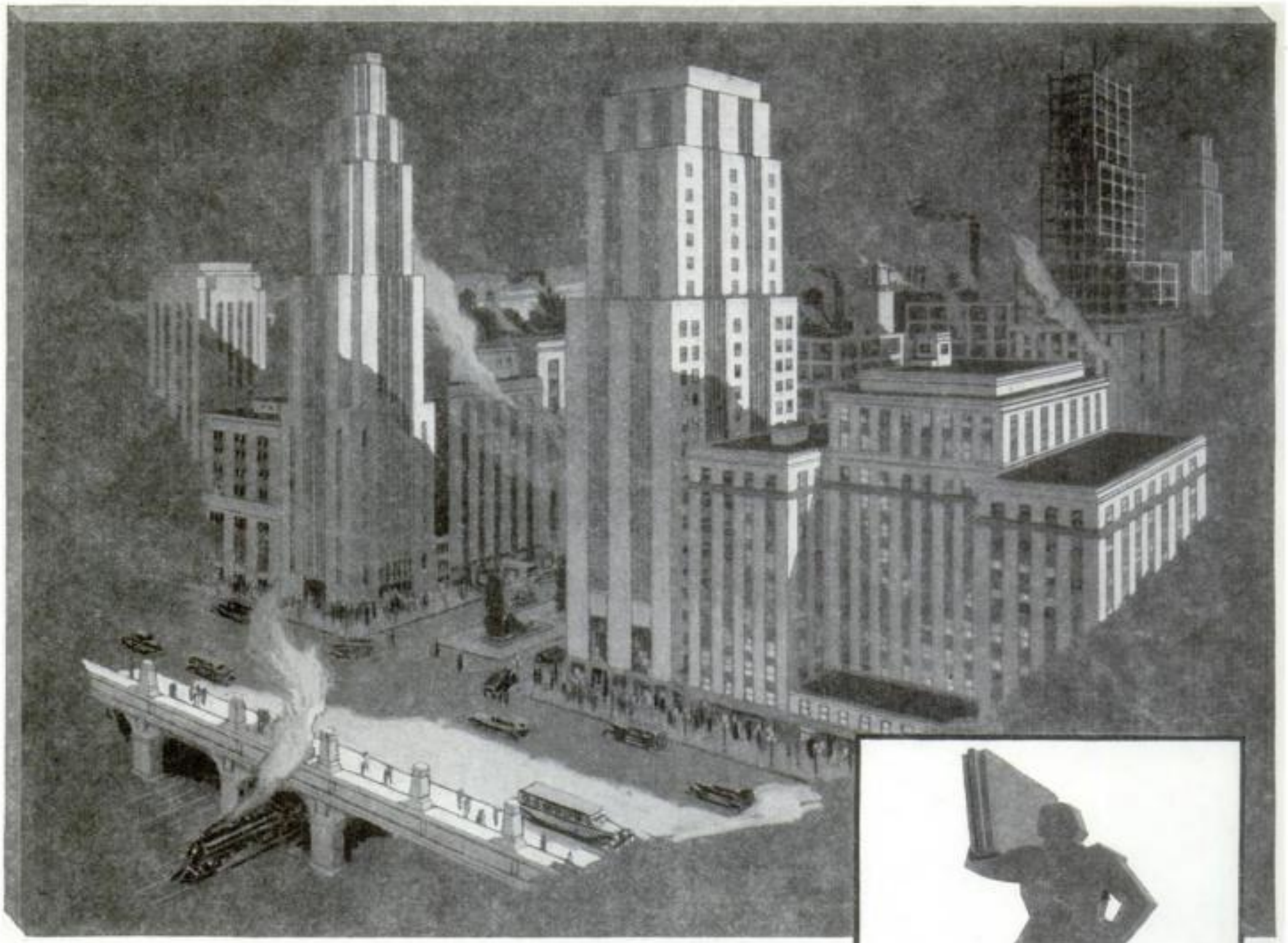
Mere steel doesn't make such a bearing. No mere group of men can make it either. It's a product, as all SKF Bearings are, of a world-wide organization that *specializes* in bearing manufacture . . . that works *up* to a predetermined standard of performance . . . never down to a price.

After all, who is there to measure by price the value of a bearing that stands up for nine years and for a million miles under the most rigorous kind of service to which any bearing is subjected . . . and that never asked for anything but oil!

SKF

BALL AND ROLLER BEARINGS

SKF INDUSTRIES, INC., 40 EAST 34TH STREET, NEW YORK, N. Y.



PRESDWOOD

TRADE MARK REG. U.S. PAT. OFF.

tempered to super-toughness

means better concrete at lower cost

Mighty walls and columns, sturdy floors, graceful bridge arches—more and more of them offer convincing evidence that Masonite* Tempered Presdwood* is ideal for structural forms.

The cost records of many varied construction jobs give positive proof that **Tempered Presdwood* forms mean better results at sharply reduced cost.**

Construction engineers, builders, architects—on the alert for better, quicker, cheaper methods—now use Tempered Presdwood*: toughened, hardened, strengthened by a unique tempering process, just as steel is tempered.

"Faster, better, cheaper"—this is construction's endless demand. Note how perfectly Tempered Presdwood,* with its many practical, economical advantages, answers this demand.

You'll want the complete story, told in our booklet. It's worth reading—interesting, and intensely practical. Just mail the coupon today.

How Tempered Presdwood improves quality, cuts costs*

Smooth finished concrete—no fins, no marks, no costly finishing. Presdwood's® 4′ x 12′ boards, impervious to moisture, make tight forms, insuring concrete of maximum density. No warping, no splits or cracks.

Use Presdwood* forms again and again. Easy, quick to put up, to strip, to clean. No wrecking and rebuilding of forms.

Eliminate ordinary wood sheathing. Form lumber reduced by one-half. Light forms, easy to handle. Low cost between jobs.

*Trade Mark Reg. U. S. Pat. Off.

Send for complete facts about Masonite* Tempered Presdwood,* Structural Insulation, Insulating Lath, QuartRboard, and Masonite* Cushioned Flooring.

Just mail the coupon for full information.

"Made in Mississippi"

Masonite

TRADE MARK REG. U.S. PAT. OFF.

PRESDWOOD

STRUCTURAL INSULATION · · INSULATING LATH · · QUARTRBOARD* · · *Cushioned* FLOORING

MASONITE* CORPORATION, Dept. D-22
111 W. Washington Street, Chicago, Ill.

Please send complete information about Masonite* Tempered Presdwood*. © M. C., 1932

Name .....

Street .....

City ..... *State* .....

I am also interested in . . .

☐ Presdwood* ☐ Structural Insulation
☐ QuartRboard* ☐ Cushioned Flooring

POPULAR SCIENCE
MONTHLY
February 1932 Vol. 120, No. 2
RAYMOND J. BROWN, *Editor*

SKIPPERS *of Great Liners Trained on* School Ships

By

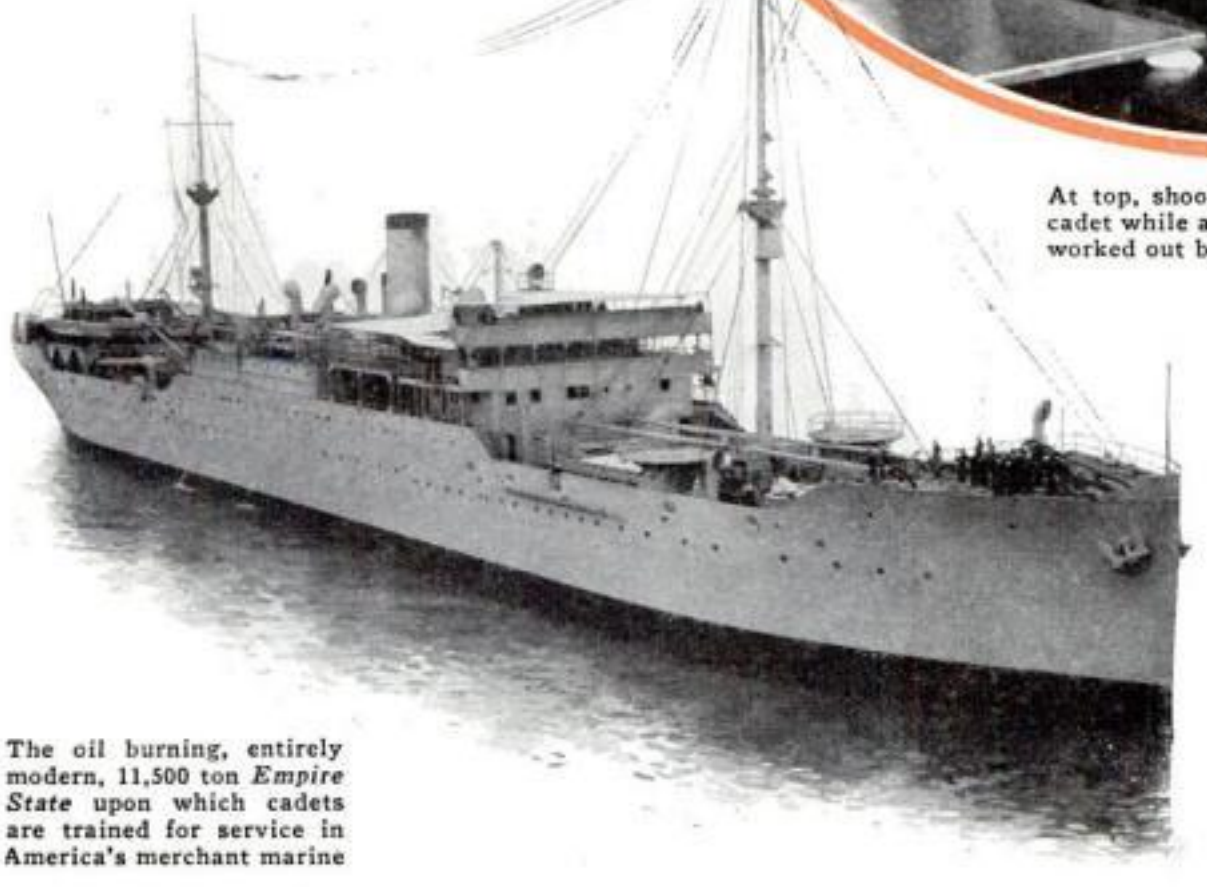
BOYDEN SPARKES

At top, shooting the sun, a duty performed twice a day by each cadet while at sea. On big blackboards, problems of navigation are worked out by the students who sit at regulation schoolroom desks

SCHOOLS, in general, are rather sedate institutions, but this one is almost bizarre. Its assembly room is the deck of a great steamer and its classes meet in chart room, cabin, and engine room. Its president is a seafaring man of long experience and its faculty consists of mates and chief engineers.

It is in a school of this kind—there are four of them in this country—that young men are trained to be officers in the American merchant marine service. There they learn all there is to know about navigating, managing and equipping a great modern vessel. There theory is overlapped with practice and things learned in the classroom are driven home by hard experience on the high seas. When men are graduated from the Merchant Marine Academy, they are sailors fully trained for the sea and prepared to meet any emergency.

All of us know about West Point, where officers for the Army are trained; we know about the Naval Academy at Annapolis where cadets are molded into the men who command the ships of our Navy; but how many know of the California, Pennsylvania, Massachusetts and New York schools that bear the same relation to our merchant marine? My story is chiefly concerned with the New York State Merchant Marine Academy because that is the only one which admits qualified American boys from any part of the United States.



The oil burning, entirely modern, 11,500 ton *Empire State* upon which cadets are trained for service in America's merchant marine

Although chiefly supported by the taxpayers of New York, the 11,500-ton American built, oil burning *Empire State*, on which these students learn their profession, was a gift from the Navy. It was part of the bargain between the national Government and the state that all American boys should be eligible. But it is not a new school; only the equipment is new; the traditions are old. The alumni are scattered through a multitude of important places and some of them are internationally famous.

WHO does not remember the thrilling rescue effected by the S. S. *America*, Captain Fried commanding? In this instance, the crew of the British steamship *Antinoe* were rescued from a sinking ship. The chief officer of the *America* was Harry Manning, a graduate of the school. It was he who commanded the boatload of volunteers that in constant peril rowed from the *America* to the sinking *Antinoe* and brought off her bedraggled crew. That was about the last voyage Manning made as chief officer of a ship, for soon after the *Antinoe* rescue they made him captain of a great liner.

The loss of the *Vestris* with hundreds of passengers would have been a worse disaster but for the superior navigational skill of another graduate of the school, Captain Schuyler F. Cummings. On November 12, 1928, when the British ship *Vestris* foundered, the radio operators of Captain Cummings' vessel, the S. S. *American Shipper*, had picked up two radio bearings that placed the *Vestris* in a certain position off Cape Henry.

When the *American Shipper* arrived at that point there was no sign of the *Vestris*. Another bearing from Cape Fear placed the *Vestris* further along and the *American Shipper* continued the desperate hunt. Thanks to close calculations by Captain Cummings in which he made allowances for current and wind, his ship came up over the horizon upon that scene of tragedy in time to rescue 102 of the survivors who were keeping afloat by means of lifeboats, life preservers, and bits of wreckage.

These incidents reveal the graduates of this school as no ordinary men.

In a two-year course, seven months of which are actually spent on the sea, the cadets of this school are given a training that fits them, in a variety of ways, for careers on sea or shore.

Captain J. H. Tomb, U. S. N., retired, is superintendent of the school at which future officers of the merchant marine are instructed

MAN THE LIFEBOAT

Heroic rescues at sea by graduates of the Marine Academy were made possible by the careful training they received in the use of lifeboats

Some of the boys on the *Empire State* want to be engineers and they study in the engine room

The great searchlights on the *Empire State* are no mystery to the students

The Lyle gun is used in shooting a life line to a stranded vessel. Above, cadets receive instruction in getting life-saving gun ready

Out in Hong Kong one of the influential men of the community is Captain R. C. Brennan, class of '03. After some years as master of various ships he has become the marine superintendent and Oriental Agent for all the ships of the Admiral Line.

Some of the graduates have left the sea entirely and used their marine educations to advantage on land. One of these is John C. Hatzel, class of 1877, who became one of Edison's pioneers and now is one of the foremost electrical contractors in New York.

There is a public square in Elmira, N. Y., named for one of the school's graduates, and the chapel at Cornell University contains a memorial window dedicated to him. He was Ross G. Marvin, who went with Admiral Peary as the navigator of his ship, *The Roosevelt*, on the expedition that did not end until Peary reached his goal, the North Pole. Marvin, who had been with Peary on his 1898 expedition, died up there in the Arctic and is believed to have been murdered by Eskimos.

W. J. Rague, a graduate of the school, found himself at twenty-one the executive officer of the naval transport *Finland* during the war. In 1919, after the armistice, one day out of Brest the captain of the *Finland* died and this boy Rague took command and brought the big ship and her company of 3,000 soldiers safely home to dock at Hoboken.

THREE ships have been used as training schools for the officers of the merchant marine. First of all was the U. S. S. *St. Mary's*, a ship rigged sloop of war, swift enough under her towers of canvas to overhaul the slavers she was built to chase. From 1844 until nine years after the Civil War, she made American history. Her white oak planking had been pierced for a line of gun ports through which cannon many times were fired in anger. Her live oak framing was pinned together with mighty bolts and spikes of red copper and when at last she became the ship of what was then called The New York Nautical School, she was as staunch as the day she left the stocks.

Captain Charles Williamson stood Number One in the first class to be graduated. The boys had been examined in navigation, steering, handling sails, use of lead, sailmaking, department and other phases of the school work. In all but two of these, Williamson was rated "excellent"; in the other subjects he was marked "very good." One other man, Washington Rodman, shared honors with Williamson in the graduating class.

Swabbing down the deck of the *Newport*, the sailing boat used as a home for the training school before the Navy turned the *Empire State* over to the future masters of our marine

Below, cadet receives instruction in navigation while taking his turn at the wheel. An officer explains to him the mysteries of the compass and how to set a course by the needle

These two and six others of the class were then signed on as the crew of the bark *Iron Age* which was loaded for Rio. After that voyage they were to seek places as mates. Five days after the bark cleared from New York she ran into heavy weather off Hatteras and Washington Rodman was ordered aloft to the fore topsail yard. He never returned, and it is supposed by those of his classmates who survive that he was shaken into the sea by a sudden pitch of the bark.

The U. S. S. *Newport*, a naval gunboat of 1,000 tons, barkentine rigged and equipped with coal-burning boilers and a single, triple expansion engine of 1,000 horsepower, was the next school ship. Commissioned in 1897 in time for service in the Spanish-American War, she was turned over to the school in 1908 and gave fine service until quite recently when the Government gave in place of her a ship eleven and a half times as big and completely modern. Not only the ship but the faculty as well is modern and the head of it fairly boils with an enthusiasm for his tremendous job of making merchant marine officers who will be a credit to the flag under which they serve.

Sails are now seldom used, but every student gets a thorough training in old-time sailing. Here the boys are seen at work making sails as industriously as though there were no oil burners

CAPTAIN J. H. Tomb, U. S. N., retired, is the superintendent of the academy and commanding officer of its ship, the S. S. *Empire State*. In the nature of things the officers of this ship are the faculty and all of them are selected by Captain Tomb.

During three of those years when Europe was plunged in war this officer was in charge of the shops of the naval gun factory in Washington. Rear Admiral J. H. Glennon characterized him after that service as "an active, ambitious, conscientious officer of sterling worth."

In March, 1918, he took command of the U. S. S. *Aroostook*, a mine planter. The mechanical genius of the American people was expressing itself then in a scheme to bottle up the German fleet and German submarines by laying a mine barrage in the North Sea. In three months time 56,000 mines were planted and of these a full share was planted by the *Aroostook*.

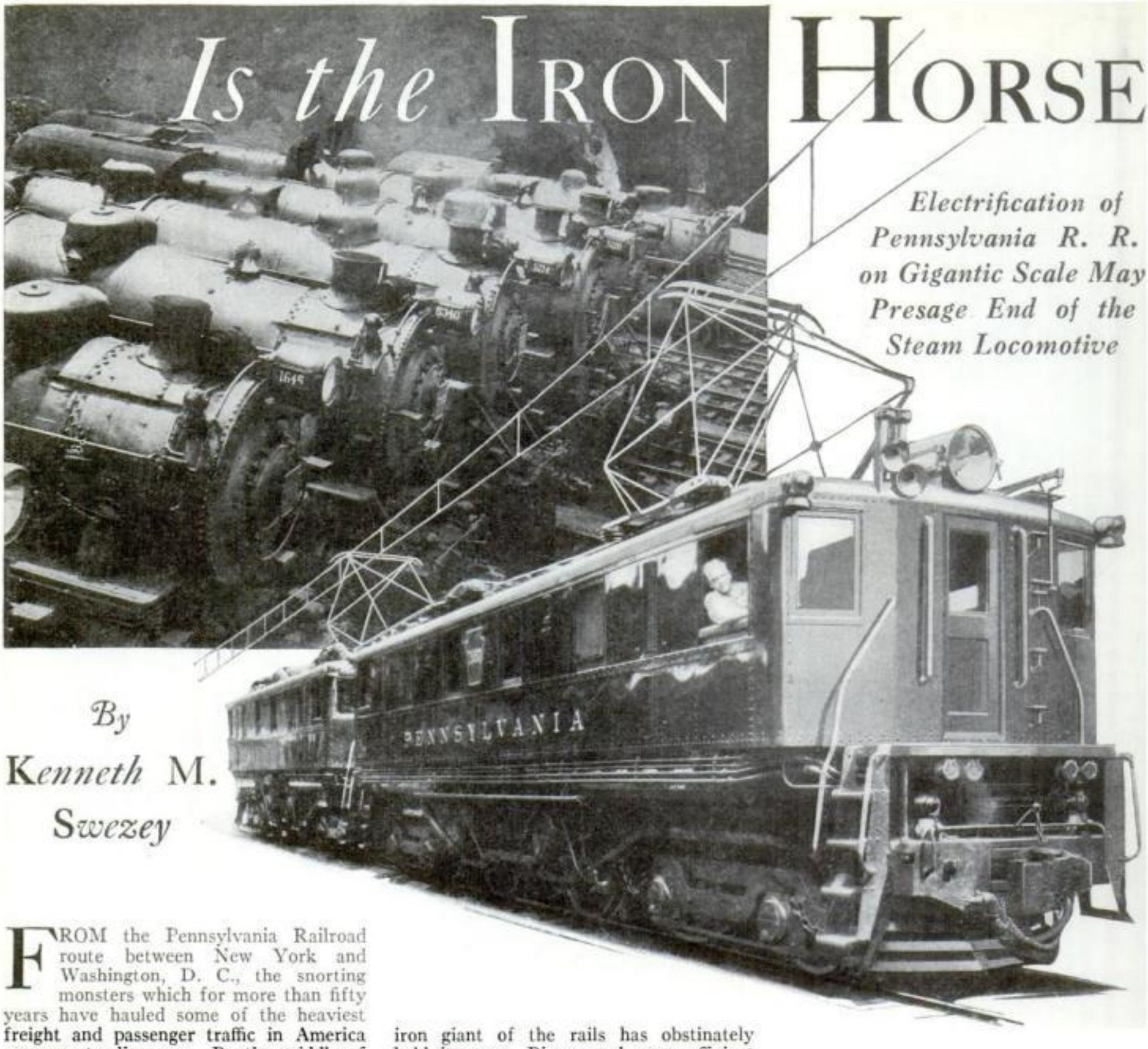
After the war, his service included command of the U. S. Naval Air station at San Diego, a period at the Naval War College at Newport, and then to sea again as Commander of a division of destroyers. There were occasions when he was in command of as many as thirty-eight destroyers maneuvering at night in battle formation without lights, testing their skill against the next enemy that America will meet on the sea.

Next his service took him to Puget Sound Navy Yard to be Captain of the Yard, where he remained until April, 1926, when he went to Panama as marine superintendent of the Panama Canal. All of these details emphasize the unusual administrative ability of this naval officer which makes it understandable why the state of New York drafted him to be the head of its merchant marine academy.

Under his tutelage the cadets are learning more than seamanship, navigation, cargo stowage, mathematics, the handling of boats and *(Continued on page 136)*

Is the IRON HORSE

Electrification of Pennsylvania R. R. on Gigantic Scale May Presage End of the Steam Locomotive



By Kenneth M. Swezey

FROM the Pennsylvania Railroad route between New York and Washington, D. C., the snorting monsters which for more than fifty years have hauled some of the heaviest freight and passenger traffic in America are soon to disappear. By the middle of 1933, at least 150 electric-powered giants, and several hundred multiple-unit cars, will be handling the entire traffic on this section of the line with a speed, smoothness, and economy never before achieved.

This greatest steam railroad electrification project, involving 325 miles of route and 1,300 miles of track and costing a hundred million dollars, marks the beginning of a new era in railroad transportation.

For almost half a century, the Iron Horse has roared across the continents of the world, snorting defiance at the threat of electricity. Without undue humiliation it let its sleek rival do the quiet and smokeless auxiliary work at terminals, in long tunnels, and on suburban and interurban passenger lines.

The hurt was deeper when electric locomotives proved themselves more capable of hauling heavy trains at high speeds over steep mountain grades. None of these auxiliary services, however, seriously affected the sovereignty of the steam locomotive over the long open trails, in the blazing of which it has made thrilling history.

While the oil lamp and the small stationary steam engine vanished before the advance of the new power, the puffing iron giant of the rails has obstinately held its own. Bigger and more efficient —embodying automatic stokers, superheaters, feedwater heaters, improved valve motion, compounding, the use of cast steel to lighten parts, greater adhesive weight—this heritage from the Age of Steam still dominates about ninety-eight percent of the main line railroad tracks of the world.

The Pennsylvania electrification, however, differs from previous electrifications in that it makes a direct and substantial advance upon what had been considered exclusive steam territory. With no special problem to solve—except an expected increase in traffic—and under no external compulsion, this railroad is substituting entire electric operation for steam operation, confident that it will thus be better able to handle the ever-growing demands of the new day.

Does this project indicate, even faintly, that the great Iron Horse, with its fascinating exuberance of power, has at last met the challenge that marks the beginning of its end?

Any answer is complicated by many conditions, technical and economic, and must necessarily contain a large element of speculation. Comparative costs of steam and electric equipment and its maintenance governs part of the problem; nature and density of traffic governs another. But no one I have asked, including representatives of several of the largest railroads in the country, is willing to deny that some day the steam locomotive may puff its last; or at least that it may be reserved for a few odd jobs. It may continue to dominate the roads for a long, long time, but it is not impossible that its day will come.

A REPRESENTATIVE of the Baldwin Locomotive Works, which has made steam locomotives since 1832 and in addition now makes the chassis for electric locomotives, told me that his company was not at present worried about an electric invasion, and assured me that the steam engine would probably remain long after the present generation had gone. A New York Central official agreed that it was entirely possible that electricity would surpersede steam for main line traction, but that the rate would depend entirely upon future developments which he dared not predict.

General W. W. Atterbury, president of the Pennsylvania Railroad, however, was

Doomed?

blunt and emphatic in telling why his company was spending a considerable fortune for electrifying. He did not hesitate to suggest that continuous electric service from Boston to Washington and from New York to Chicago could be expected in the not far distant future.

"THE electrically-powered train," he said, "makes better time and can haul greater loads. It has a quicker pick-up in starting and can be stopped in a much shorter distance than the steam-powered train. Between Washington and New York, use of electric power will give us more than the equivalent of an additional track. It will cut a full hour or more off our present running time without sacrificing one iota of safety. It will eliminate the smoke nuisance and the bother of stopping the train for the taking on of coal and water.

"It is necessary on the present New York-Chicago runs to make three or four changes of steam locomotives as a precaution against mechanical troubles, for steam locomotives must be taken to the shop for attention at fairly frequent intervals. Electric-powered trains could make the same runs many times without a stop or special mechanical attention. They would make a fourteen-hour schedule a simple matter between these two largest cities of the United States.

"Along the coast I expect to see unbroken electric service from Washington to Boston."

With such a statement, coming from such an authority, it is not difficult to imagine that the next few years will see a progress of electrification at a rate unprecedented in the past, particularly through the densely populated areas between the cities mentioned. The first challenge to electrify steam roads was made by the trolley car, in the early '90's; the next and more impressive challenge will be made by electrified steam railways themselves.

The locomotives that will inaugurate the New York-Washington service represent the last word in such equipment. All the experience of the Westinghouse and General Electric

Erecting new and higher signal bridge for electric overhead work

At right, linemen installing one of the big insulators needed by electric railway systems

Photos by Wm. Rittase

One man, comfortably sheltered from the weather, runs an electric engine

The constant attention of two men is needed in the roaring cab of the big modern steam engine

Companies, the Baldwin Locomotive Works, and the Pennsylvania Railroad has been pooled in their design. Indeed, the term "motive power unit" is more descriptive than "locomotive," for these new electric engines, although complete in themselves, may be coupled together in groups of two or three to build power sufficient to haul the heaviest train that coupling equipment can hold together.

The units that will specialize in hauling freight will have four motors and eight driving wheels and will develop more than 2,000 horsepower. Sixty are being built. The passenger motive power units will be of two types, one having four motors and four driving wheels and the other having six motors and six driving wheels. They will develop more than 2,000 and 3,000 horsepower, respectively. Ninety of these have been ordered.

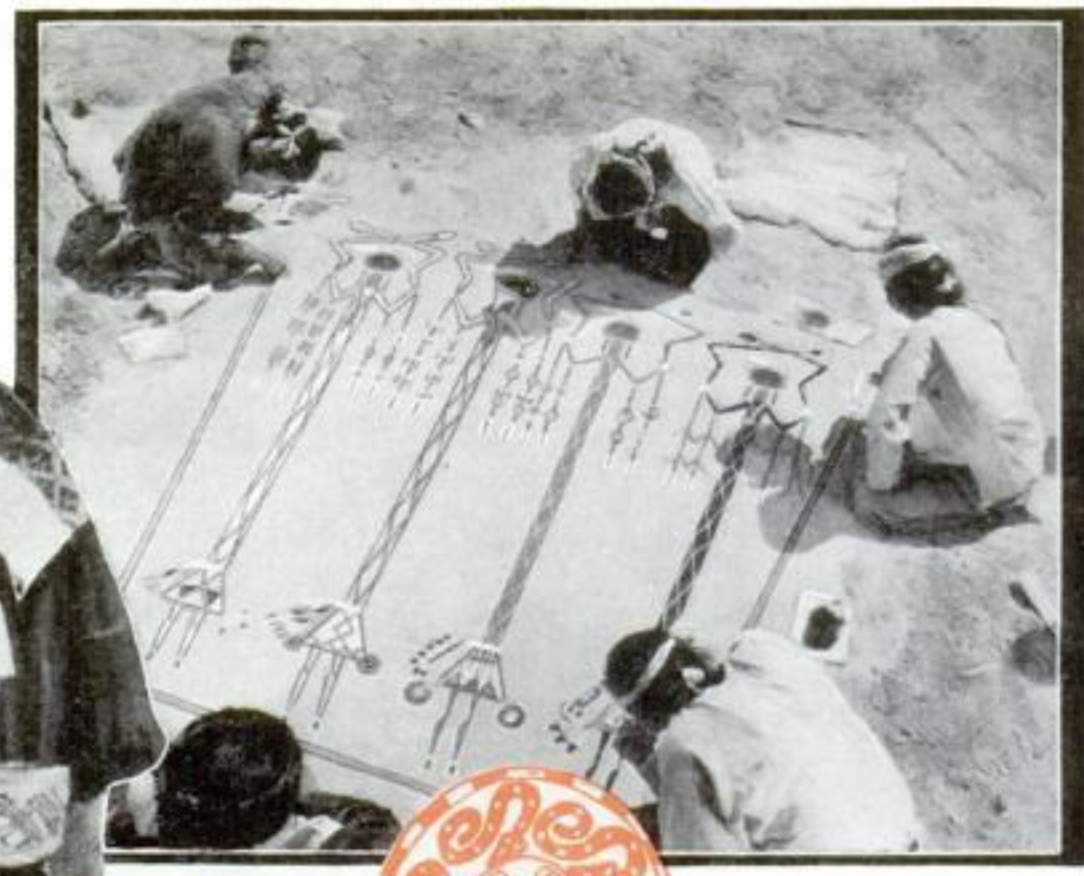
A NUMBER of these new locomotives have for many months been pacing back and forth over the sixty miles of already electrified route between Trenton, N. J., and Wilmington, Del., proving their mettle. How fast could they go? How much could they pull? How smoothly and quickly could they accelerate and stop? How would they stand up under the grueling demands of practice? Every moment of the several hundred thousand miles of performance to date has been checked.

As a result of the tests, the railroad is confident that with electric operation freight trains of at least 125 cars may be hauled at speeds exceeding fifty miles an hour; while passenger trains may be operated with perfect safety at speeds as high as ninety miles an hour!

To hasten the completion of the roadside and overhead work, some 6,000 men are now placing foundations, erecting poles and other structures, stringing wires, bonding rails, and putting up new signal bridges. Into this construction are going 39,000,000 pounds of copper and bronze and 150,000 tons of steel.

Working for months during the quiet hours of the night, gangs of men have lowered the tracks in the tunnels under the Hudson and East Rivers, and have cut sockets for insulators in the roof of each tunnel to give clearance for the overhead wires. For the complete length of the electrifica- *(Continued on page 132)*

Tobat-Ko, chief of the Huicholes and master of its medicine men, attired in ceremonial garments, arrows in belt and medicine pouch around neck



At left, Navajo medicine men making medicinal sand painting to cure sick members of their tribe. Below, skull with bit of bone cut out by a native surgeon centuries before our time

By RAMON MENA, M.D., M. SC.
Curator of Primitive Medicine, National Museum of Mexico

Stone-Age Surgeons

Recent Intensive Research Gives High Rank to

IN THE shelter of a granite cliff, on the headwaters of the Meta River in upper Bogota, a six-foot, bronzed Chibcha Indian lay on a vicuna skin. On his head was a mass of finely chewed coca leaves. From a clay cup he drank quantities of an infusion made from the cocaine-bearing coca leaves. Beside him knelt another and slightly older Indian, at whose side was spread a piece of white deerskin, upon which lay a dozen or more sharp splinters of black obsidian and white flint. In a mortar a younger Indian pulverized more coca leaves, mixing them with small quantities of lime and a little water.

A beaten gold plaque, about six inches long by three wide, hammered in the form of a bird with a snake's body, marked the older Indian as a medicine man of the Chibchas, once rivals of the Incas for the mastery of empire in South America. We came on this scene in 1929, yet we were looking at a major surgical operation which was being done exactly as similar operations were done by the more civilized tribes in the New World more than two thousand years ago.

The stone-age surgeon removed the mass of coca leaves from the patient's scalp. With a long, thin, curved splinter of obsidian, he cut around the base of a lump on the man's head. Selecting a heavier obsidian knife from his deerskin kit, he cut beneath the base of the lump and carved away the bone of the skull. As he worked he poured the dark brown infusion of coca leaves over the wound.

With the last stroke of the obsidian blade, he lifted from the patient's head a bone-tumor that had grown into the skull. To do this, he had had to remove about one third of the thickness of the skull at the central point of the malignant growth.

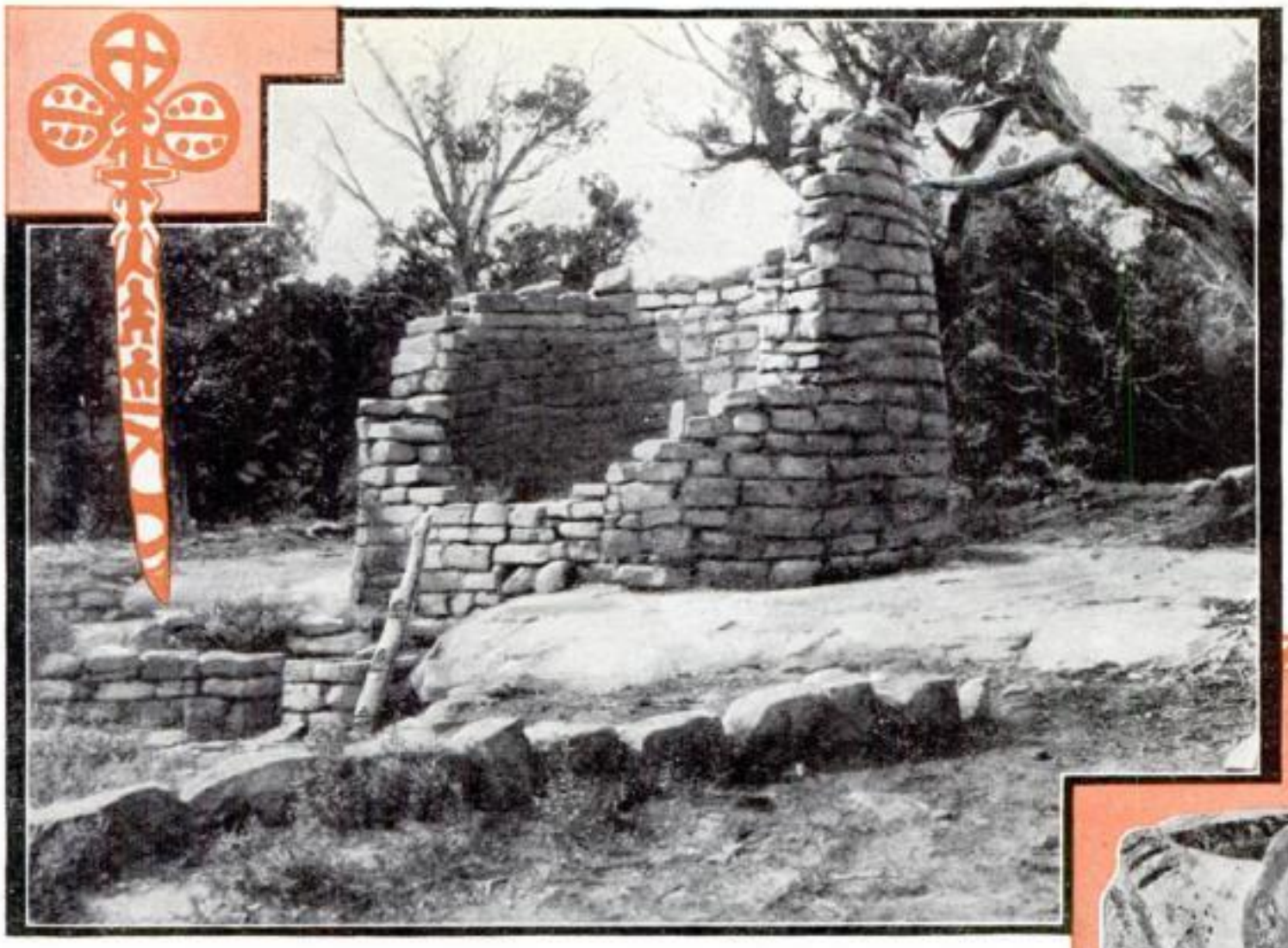
The medicine man, paying no more attention to me than would a modern surgeon performing a delicate operation, replaced the lifted section of the scalp and bound it down with a softly-woven cotton bandage. Then he packed the surface with more crushed leaves of the ever-essential coca with its pain-easing cocaine, and rose to greet us. The patient moved a little, groaned, gritted his teeth on the hardwood stick between his jaws. In ten days he was as well as ever.

We had seen stone-age surgery, as well performed as it was among these Chibchas, or Muyscas, and the Incas many centuries before Europe discovered America. According to Dr. Spencer L. Rogers, who has made a careful study of aboriginal American surgery, sixty percent of the operations on the skull were successful. This compares favorably with the percentage of success in modern skull operations; at the time of the Civil War, American surgeons saved only about forty percent of their skull-cutting cases.

The Incas are gone forever, and the Chibchas apparently alone retain the art of bone surgery, though a little of it is practiced by the few remaining Mayas in remote Quintana Roo, and the Tepehuanes in northwestern Mexico. Many Indian races of the New World, however, still depend on their own physicians.

It is only within the last few years that science has begun to differentiate between the real man of medicine among these primitive people, and the priests *(shamans)* or medicine men. We are learning that in the most advanced tribes, the physician and surgeon often was not a member of the priesthood, using little magic, sleight-of-hand, taboos, chants, or other similar forms of superstitious medical treatment.

To this day, the Apaches, the Navajo, some of the Pueblos, the Yaqui, Huicholes, Coras, Chontales and many other tribes care for their own dislocations of joints, broken bones, strained muscles, and a number of internal ills. Their treatments are successful in almost as great a percentage of cases as are those of the white physicians. Indeed, we have borrowed not a few of their medicines, while one of the



At left, entrance to Pueblo Indian operating room. Opening leads to underground room where doctors and priests held meetings

had Modern Skill

Medicine Men of Primitive American Indians

best splints for the holding of broken bones comes from a tribe in the Philippine Islands. Some of these primitive men of medicine are excellent osteopaths, though their knowledge of anatomy comes only from experience and from such information as they can remember from the talk of their predecessors among physicians of the tribe.

We laugh at the deer and buzzard headdress of the primitive medicine man; his gourd rattle, necklace of human teeth, shin-bone flute, and booming drum. Yet, I have seen warriors among the Chontales, a hardy race of southern Mexico, hypnotized by hours of listening to a monotonous single stroke of the medicine man's drum, until they sustained the removal of glass and bone arrowheads which were buried in the muscles of the back and hips. True, infusions of narcotic leaves were given them, but apparently not of sufficient strength to put them to sleep.

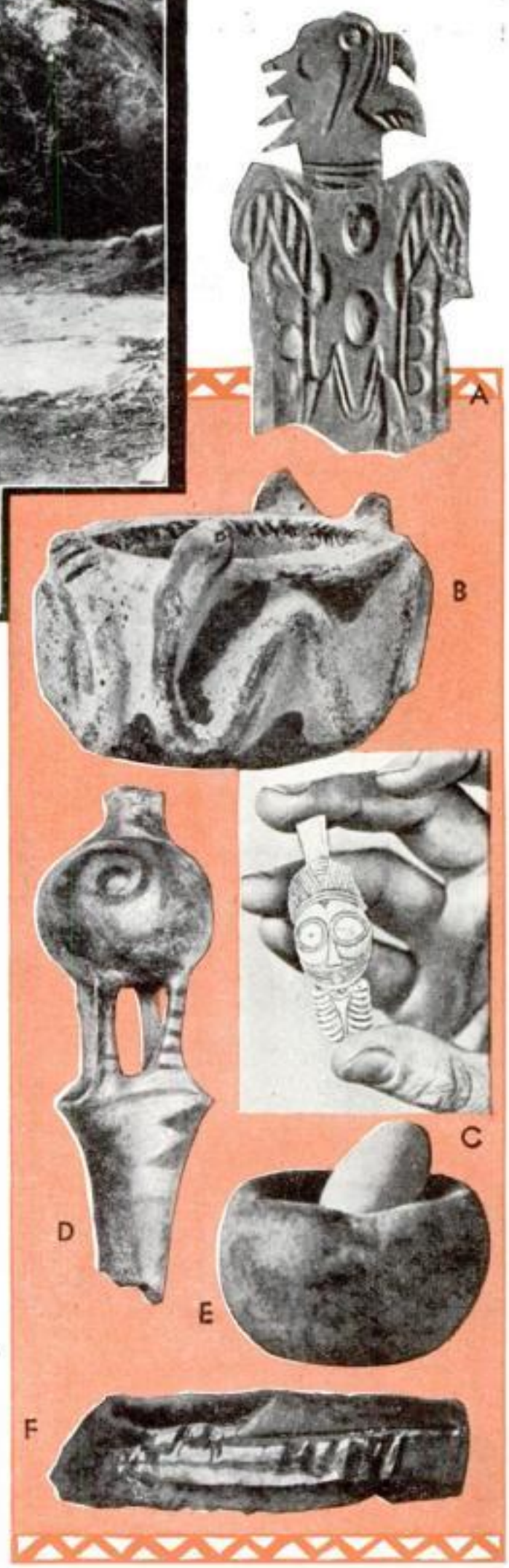
Among the Huicholes of western Mexico —who call themselves Vishalika, literally "doctors," because every fourth man among them practices medicine—I have seen compound fractures of leg and arm bones set in a manner to rival the best of our modern procedure with the aid of X-rays.

This tribe practices trial marriage, punishes adultery with death, and lives a completely coöperative tribal life, so that it has neither rich nor poor. Its medicine men are separated from the priesthood in most matters, but allied with it in others, such as births, deaths, and killings growing out of individual quarrels within the tribe.

A splint developed by these Huicholes consists in covering the limb, after it has been set, with a quick-hardening clay, and then pressing down over this a sheet of flexible bark that hardens in tubular shape. This is a primitive form of the plaster-of-Paris cast in which our surgeons still hold our broken bones. From blood-tumors, bruises, abscesses and similar growths, the Huichol physician draws the blood and pus with a bone tube, enlarged at one end, strikingly similar to our cupping process. This tube and the splint were used by these Indians ten centuries before white men came to America!

In what is now the United States, the Apaches, and southward the now-extinct Tubares, the Tepehuanes, the Mayas, the Chibchas, and probably the Incas, had a crude but effective form of dental surgery, in which they removed aching and decayed teeth with the assistance of cocaine, obtained by the maceration, chewing, and infusion of coca leaves, or other narcotic plants. So, by injections of cocaine and its derivatives, the modern dental surgeon relieves us of aching teeth.

In some of the Inca and Chibcha tombs have been found teeth with bits of mother-of-pearl, turquoise, and other ornamental materials inlaid in them. This is believed to have been for ornamental purposes only, but some of the inlay was as perfectly done as was ever any modern filling. I once saw *(Continued on page 128)*



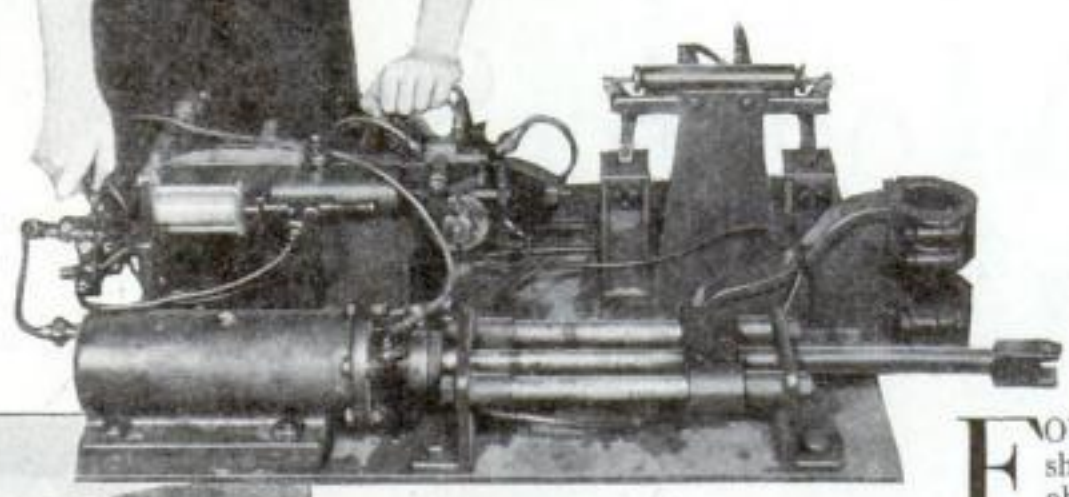
(A) Hammered copper breastplate worn by medicine men of ancient tribe. (B) Medicine man's sacred rattlesnake bowl. (C) Bone image used to bring death to an enemy. (D) Hand burner in which primitive surgeons made their anesthesia. (E) Mortar for pounding drugs. (F) Black obsidian surgeon's knife

U. S. Navy *gets* CREWLESS

GHOST FLEET

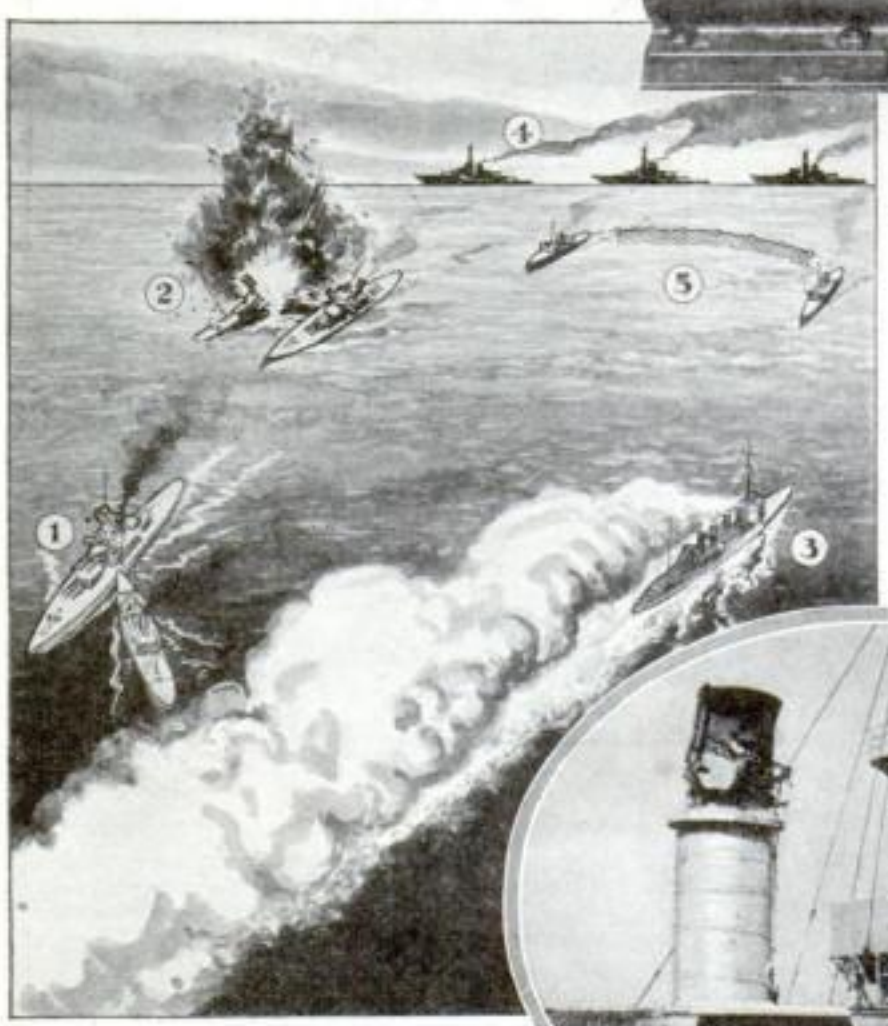
for WAR and PEACE

This little black box, with its keys arranged like those on a typewriter, put on the bridge of the control ship, governs the movements of the ghost vessel



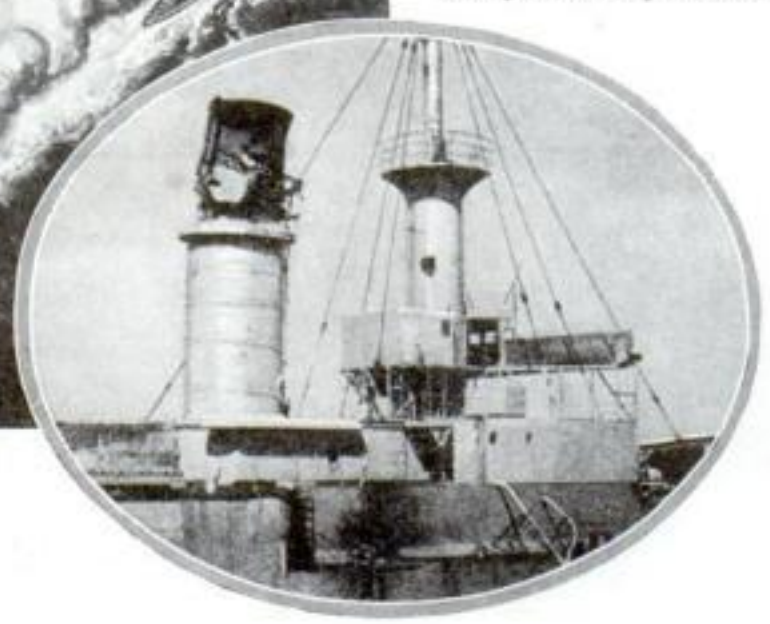
At left, one of the mechanical robots designed by John Hays Hammond, Jr., and placed aboard the *Iowa*, above

By
EDGAR O. LYONS



IF WAR CAME

1. A ghost ship could be used to ram and sink vessels of enemy's fleet. 2. Filled with explosive, it could be sent alongside an enemy warship and detonated by radio key. 3. The ghost fleet could lay a smoke screen to hide movements of real fleet. 4. Used as a dummy fleet it could mislead the enemy, acting as decoy. 5. Radio controlled ships as mine sweepers seem practicable



At right, the radio controlled battleship *Zaehringen* which was used by the German fleet as a target. Its shattered funnel shows the effect of a direct hit, but in general the ghost ships dodge bombs and shells

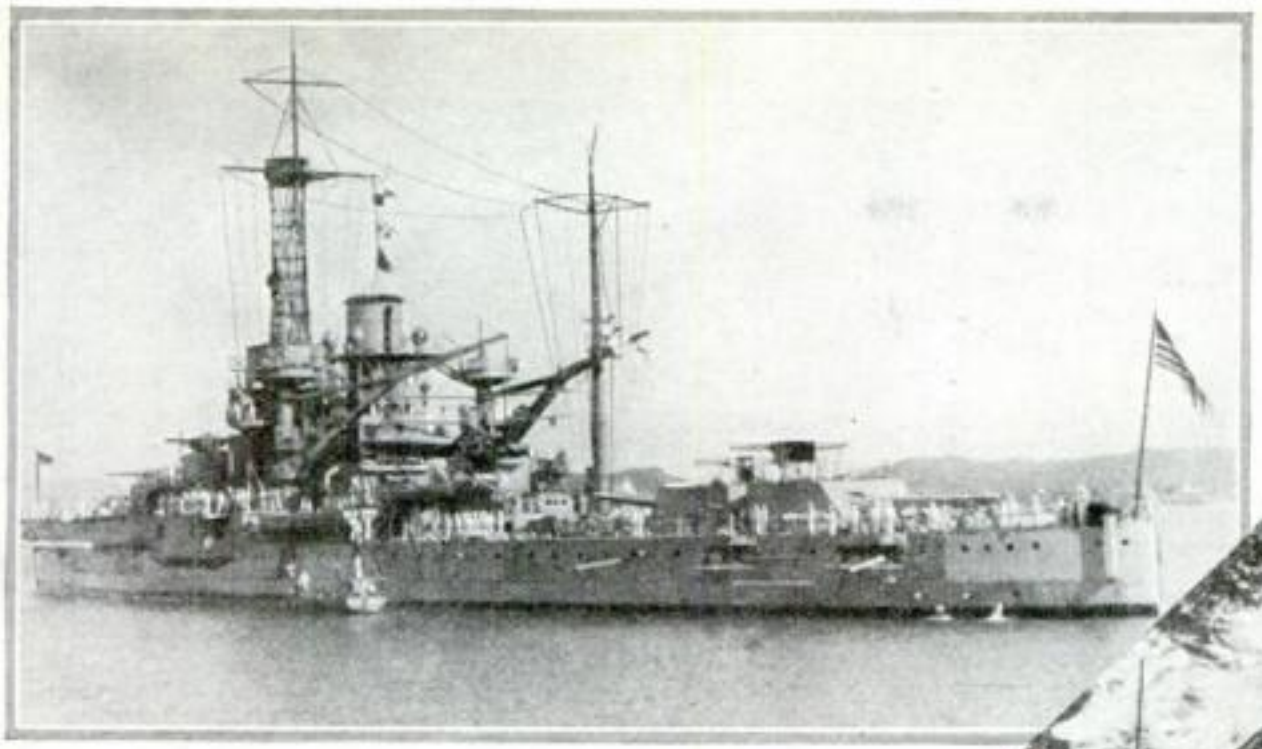
FOUR gray mystery ships, without a man aboard, are soon to sail the seas for Uncle Sam. Controlled entirely by radio from distant vessels, this battleship and three destroyers will become a new branch of the Navy known as the Ghost Fleet.

Aboard the ships there will be no voices giving orders, no footsteps in the companionways. Only the throbbing of the engines, and an occasional whirr of gears as the rudder swings to change the course, will break the silence. Above decks on each ship, two black spheres will hang from the foremast, and red, white, and blue code pennants will flutter on the halyards, warning other vessels, "Danger—Keep Clear! Ship Not under Control!"

This is a conservative precaution. A radio transmitter on a control ship, so far away at times that only the smoke from the crewless vessel's funnels will be visible, will govern its every movement—start it, stop it, blink its lights, and sound its siren. That this wonder is practicable was demonstrated a few months ago when the first vessel of the new Ghost Fleet, the low, rakish destroyer *Stoddert*, was equipped with radio-control apparatus and sent for a crewless spin off the Pacific coast (P. S. M., Oct. '31, p. 29).

So successfully did the crewless *Stoddert* play tag with its smaller control ship that the Navy has rushed forward its

Radio Controlled Ships May Work Revolution in Warfare on the High Sea



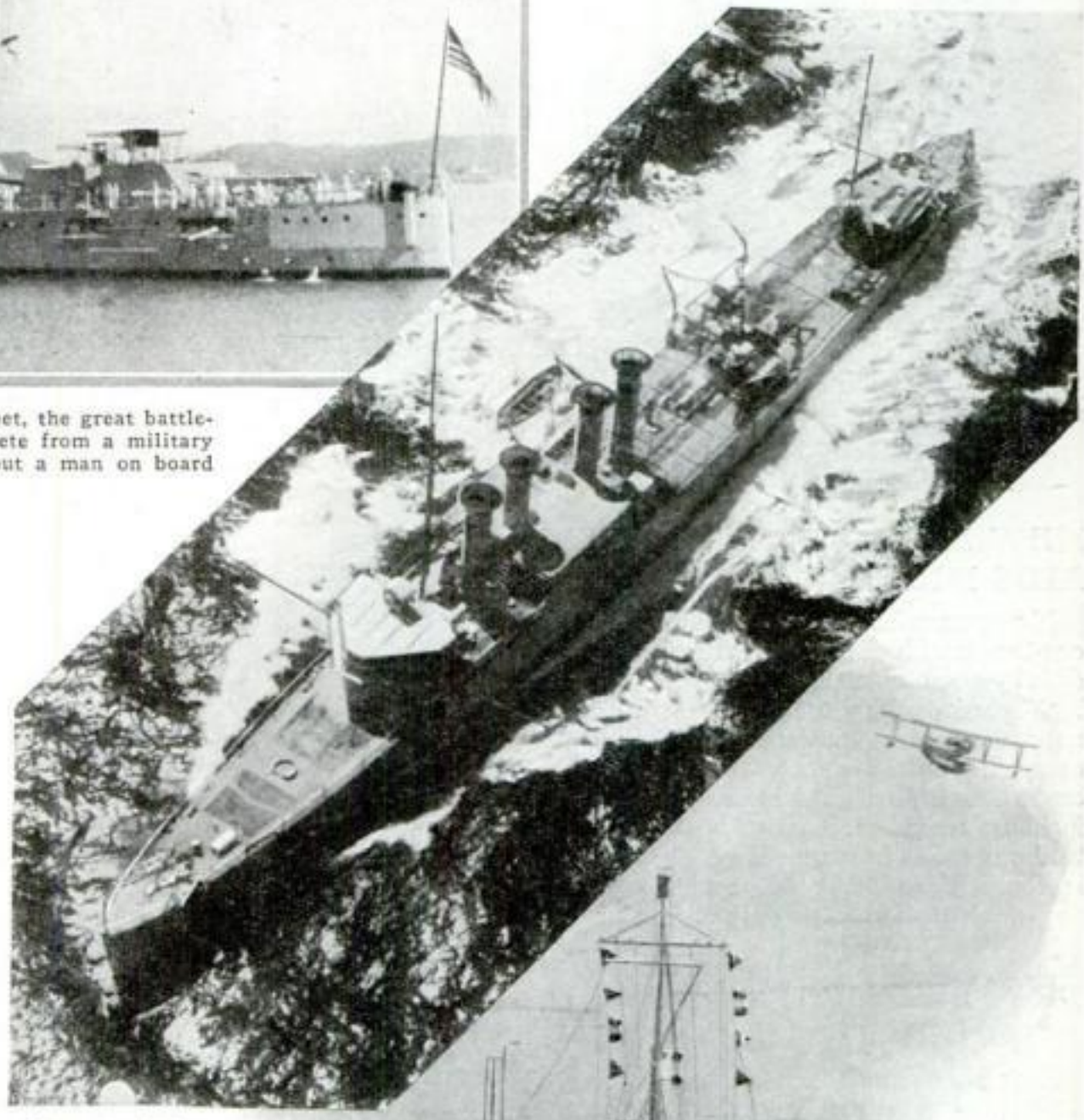
Here is the leader of the Navy's new Ghost Fleet, the great battleship *Utah*. This impressive vessel, now obsolete from a military standpoint, will dash through the waves without a man on board

plans for the remaining units of the greatest radio-controlled fleet the world has ever known. The battleship *Utah* will begin its strange ghost career next April; the destroyer *Boggs* soon after; and the destroyer *Kilty* in the fall of 1932.

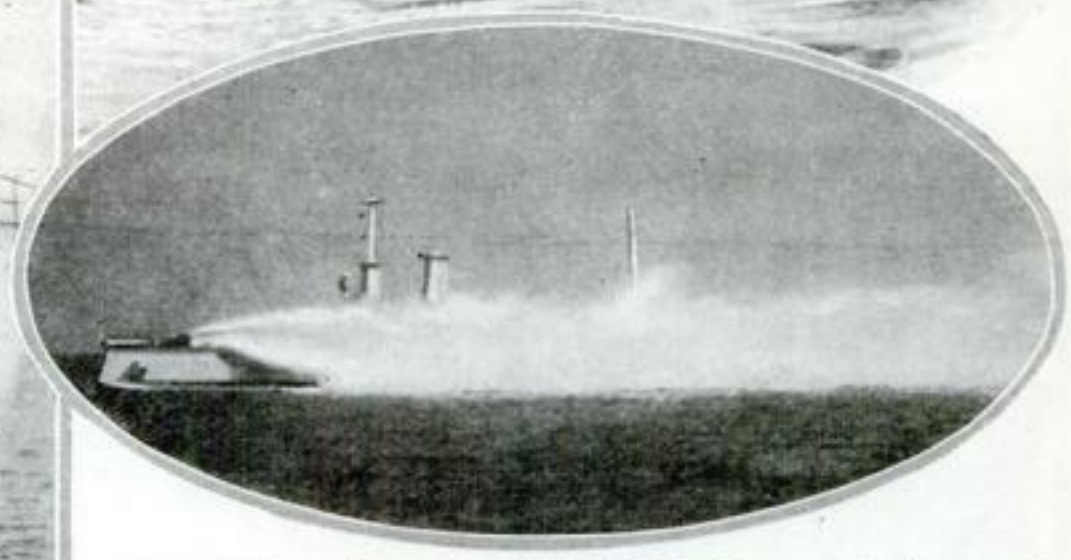
The purpose of the phantom fleet? First, to give gobs something more lifelike to shoot at than the usual targets for gunnery practice—rafts towed within range of the big guns. The vessels chosen for the Ghost Fleet are, by modern standards, obsolete. Instead of being dismantled, they are to be sent scudding across the waves without a man aboard as live, dodging targets, while battleships' guns and airplane's bombs throw up columns of spray around them. Navy officials say that there is no better way of simulating actual battle conditions. Moreover, the Navy hopes to learn facts hitherto unknown about the maneuverability of a warship after it has been jarred and torn by direct hits.

There is another fascinating side to the Ghost Fleet—one toward which the Navy maintains guarded silence. What would be its use in the event of war?

Because crewless ships could dart without hesitation through gunfire that no captain of a *(Continued on page 130)*



Above, airplane view of the radio-controlled *Stoddert*. Helmets over funnels keep bombs from hitting vital parts. At right, plane above *Stoddert* which has no crew



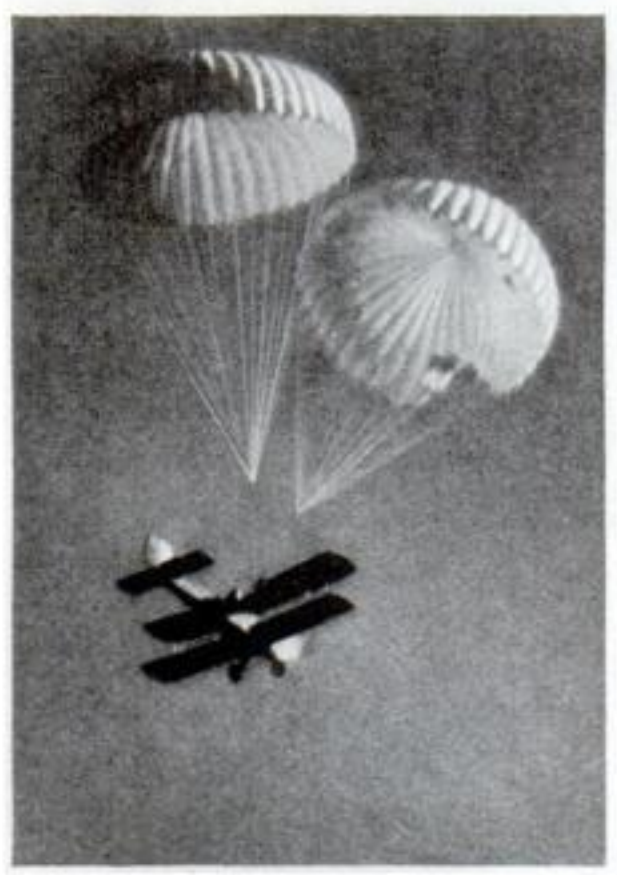
In oval, Germany's crewless battleship, *Zaehringen*, releasing a smoke screen behind which the real fleet could maneuver. At left, workmen installing smoke emitters aboard the *Zaehringen*, preparatory to radio test

NEW SPEED X-RAY TUBE AIDS DISEASE SUFFERERS

X-RAY snapshots with exposure of only one-thousandth of a second are made possible by a remarkable new X-ray tube. The high-speed device permits the early diagnosis of diseases hitherto unrecognizable except in their later stages, and is considered a boon to physicians. Designed by Westinghouse engineers, it contains three electrodes instead of the usual two. The device is compact and easy to manipulate, as shown in the photograph of the tube above.

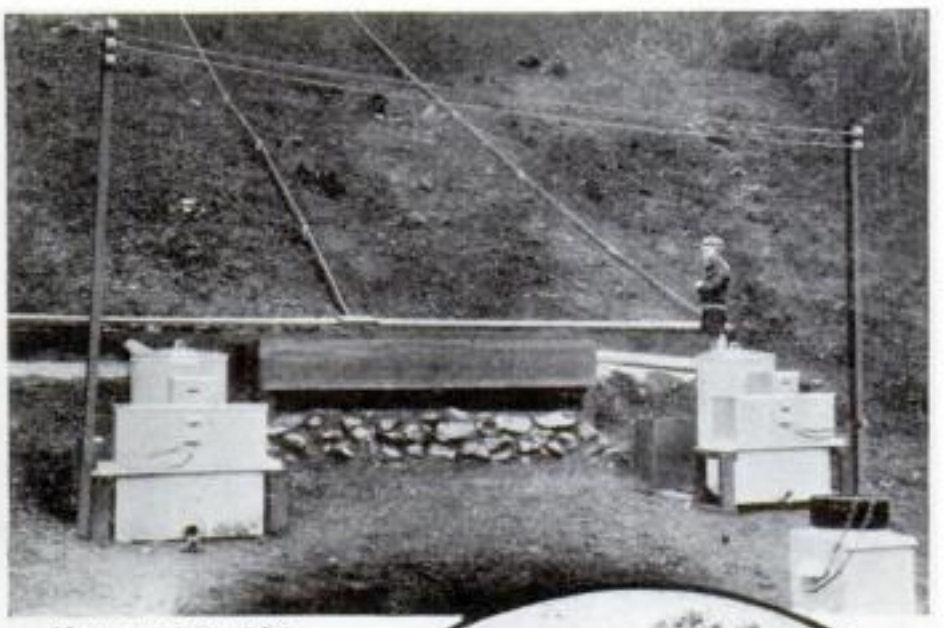
TRY TWIN PARACHUTES TO LOWER AIRPLANE

SEEKING a parachute capable of landing a whole airplane safely in case of emergency, inventors have now turned to the idea of a twin 'chute. A device of this kind was recently tested at a St. Charles, Ill., flying field. The two large parachutes seen in the photograph at right are normally packed in containers on the upper wing. When the pilot pulls a trigger, compressed air shoots out two small pilot 'chutes and these in turn pull open the big ones, which are expected to lower the entire plane safely to earth.



MAN-MADE FLOODS TEST SOIL EROSION

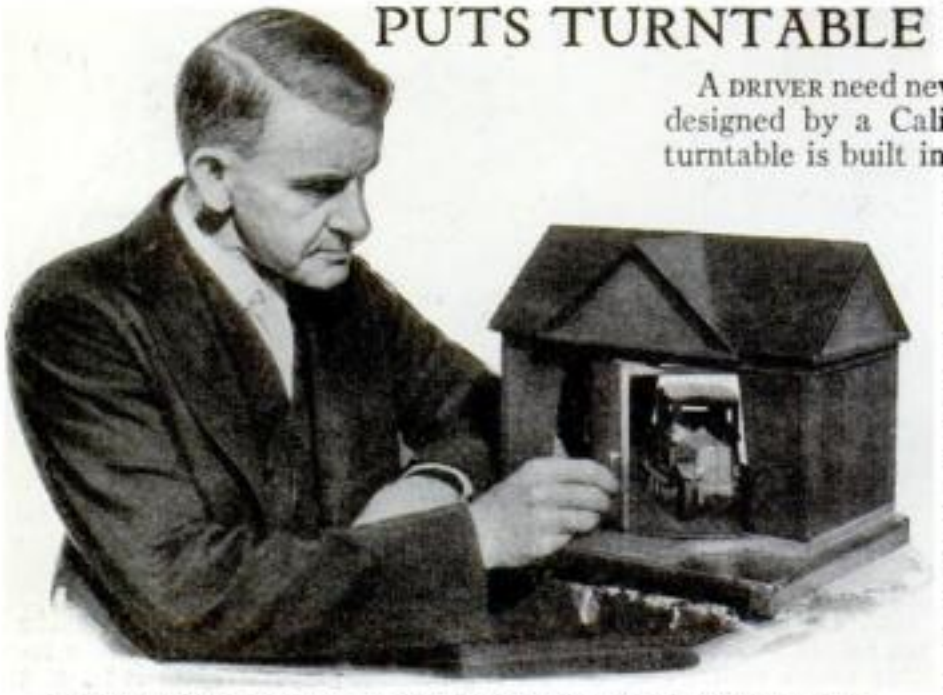
MAN-MADE floods are being produced to order at San Dimas, Calif., where the U. S. Forest Service is seeking ways to prevent the erosion of soil by rainfall. Experimenters have inclosed hillside plots and subjected them to synthetic rainstorms in making erosion tests. Tanks at the bottom collect the water running off so that it may be measured accurately, as is the amount of the water supplied in the form of artificial rain. The tests show that 2,000 times as much water runs off from the surface of barren hillsides as from similar plots carpeted with vegetation and moss, causing correspondingly greater destruction of the soil. One of the plots, gullied by torrents of water, is shown in the photograph at the right.



Above, tank in which water from synthetic flood is collected and measured. At right, hillside after a test flood hit it

CHART SYMBOLS GIVE TELEVISION FOCUS

JUST as a camera must be focused, so must a television transmitter be focused in order to give sharp pictures. To test the adjustment of the transmitter, odd charts like the one in the picture below are used. When the strange forms on the white card —circles, hearts, tridents, keys, and scissors—are plainly distinguishable on the studio's own receiving screen, the apparatus is considered to be properly focused and ready for a broadcast.



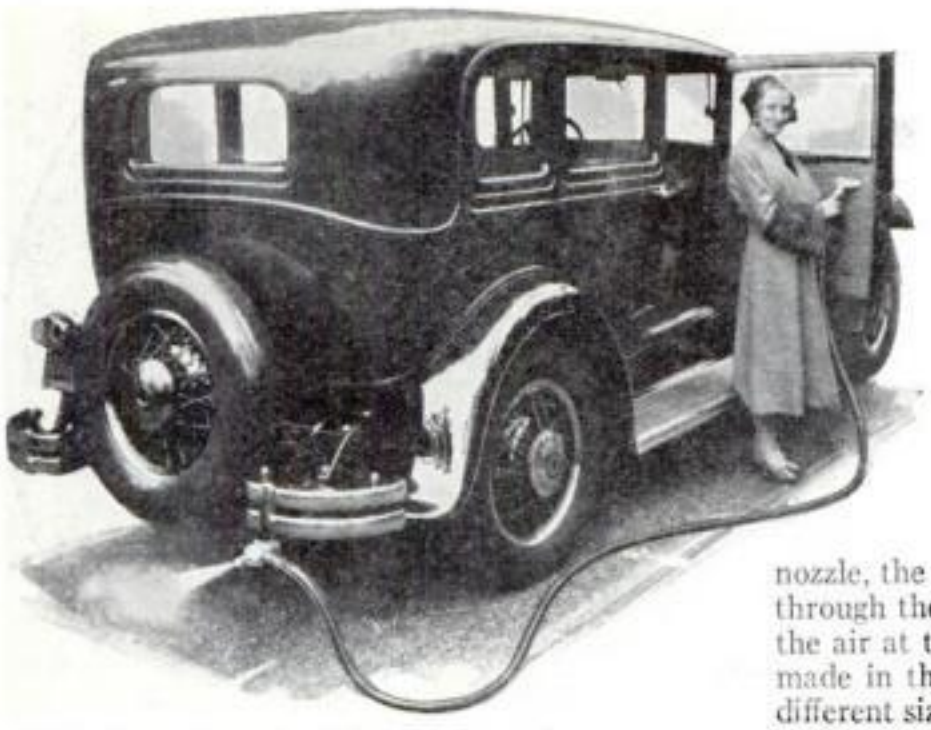
Turntable in this garage swings the car around and avoids backing

PUTS TURNTABLE IN GARAGE

A DRIVER need never back out of a garage designed by a California inventor, for a turntable is built into it. A scale model of the proposed building was recently exhibited in Los Angeles; such a structure, according to the inventor, could be built and equipped with this convenience for $350. The completed garage would be sixteen to eighteen feet long and eight to ten feet wide. Its turntable is a stall which is revolved by hand power on ball bearings at top and bottom.

If these figures are clear on television screen, the apparatus is properly focused

USE CAR'S EXHAUST TO CLEAN CUSHIONS



With the car's engine idling, gas from the exhaust creates a vacuum that cleans the cushions

USING the exhaust gas of the automobile to clean the upholstery is the accomplishment of a recently invented device. An aluminum attachment is fastened to the exhaust pipe and the engine is allowed to idle. As the exhaust gas passes through this device suction is created at the inlet hole. Collected by a nozzle, the dust and dirt are drawn through the hose and expelled into the air at the rear of the car. It is made in three models, for cars of different size.

MESSENGER CURRENTS TO CONTROL HOME HEATER

AN ENGINEER sitting at a desk in a distant power plant may start and stop water heaters and other devices in thousands of homes, one of these days, through the use of "carrier" or messenger currents. These currents travel along the wires that supply regular electric power, without interference, and operate controls on each individual device. Such a system would enable an electric company to supply economical power during the night and at other times when the regular demand was light.

MEMORIAL TO COLUMBUS IS EARTHQUAKE-PROOF

EARTHQUAKE-PROOF because of its massive and low-hung design, an impressive memorial is to be erected on the island of Santo Domingo in the Caribbean Sea to commemorate the arrival of Columbus on his historic voyage. It will be floodlit and surmounted by a powerful beacon, to serve as a lighthouse for mariners and airmen. An airport is to be built nearby. The design for the Columbus memorial, a tapering cross in form, was conceived by a twenty-four-year-old British architect, and recently was selected as the best of 450 submitted from architects of forty countries in an international competition.

BRICKS IN SHAKESPEARE MEMORIAL ARE CARVED

SCULPTURE upon bricks is a novel form of art that has just made its appearance in the Shakespeare Memorial Theater being completed at Stratford-on-Avon, England. First, extra large bricks were laid in the wall. Then Eric Kennington, noted sculptor, chiseled figures from the projecting ends of the brick as shown in the photograph.

TWO-LIGHT PISTOL NOW RUNS AIR TRAFFIC

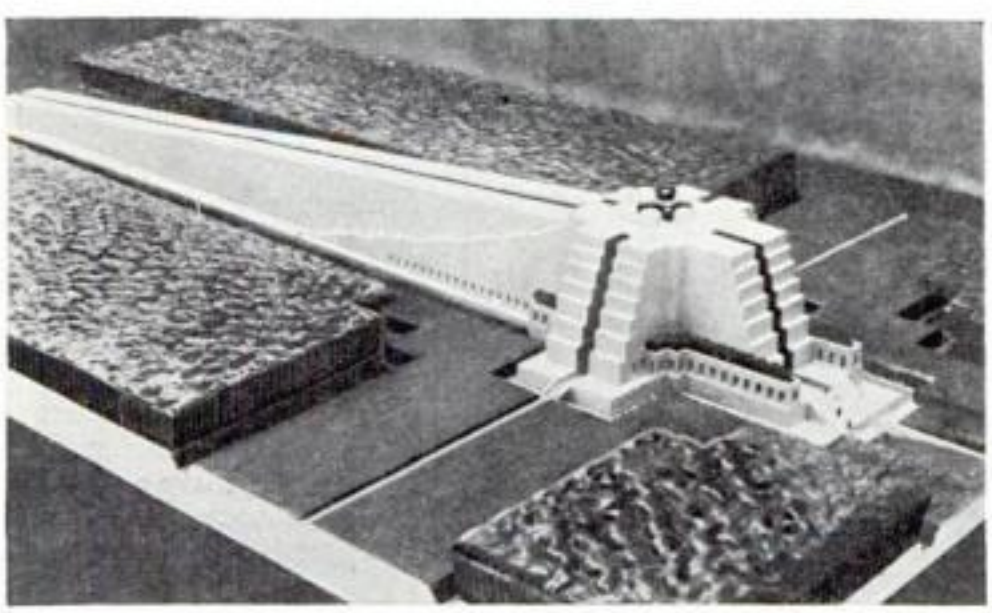
BY AIMING a new hand traffic light at a plane and pulling the trigger, an airport dispatcher can give a pilot the signal to take off. Similarly operated, a red light in the same device warns a plane coming in to stop taxiing along the runway. The newly invented stop-go light is provided with two pistol grips for easy handling.

ENERGY IN A BATTERY

ENOUGH energy can be stored in an electric storage battery, one maker has computed, to lift its own weight more than six miles, or from sea level to a point considerably higher than the summit of Mount Everest in Asia.

SIGNS GUARD INVALIDS FROM HONKING CARS

WHEN the city surveyor of Birmingham, England, recently sought a way to end the honking of automobiles outside the homes of sick persons, he devised the means shown in the photograph. Signs bearing a warning legend were prepared and placed in readiness by city officials. Now a written or telephoned request brings a messenger who will affix the notice outside the afflicted home, to stay until it is no longer needed. The scheme is a boon to invalids, as public hospitals have hitherto been the only ones favored with "Quiet" signs.



This memorial to Columbus on Santo Domingo is earthquake-proof

"Drive quietly" signs now used in English city to stop noise near sick home

NEW ORIENTAL INSTITUTE TRACES MAN'S HISTORY FOR 5,000 YEARS

At left, winged Assyrian bull weighing forty tons set up in Oriental Institute at Chicago. At right, group of Egyptian statues made 5,000 years ago

His forty-year ambition to portray man's rise from savagery more vividly than ever before has just been realized by Prof. James H. Breasted, of the University of Chicago. As a youth he visioned a great hall devoted to exhibits tracing the history of past civilizations. That dream has come true in the Oriental Institute just opened on the university campus, which is the largest archeological institution in the world. In one of the great exhibition halls devoted to Babylonian history, a visitor may see masses of business documents dating back nearly to 3,000 B. C. The Egyptian hall contains a group of statuettes with which a cemetery official equipped his tomb nearly 5,000 years ago, representing his children and servants grinding flour, baking bread, brewing beer, and casting metal. A forty-ton exhibit is a winged Assyrian bull that once guarded a palace. A large proportion of the exhibits were personally unearthed by Prof. Breasted in his notable expeditions.

MOST POWERFUL MICROSCOPE

Most powerful in the world is a microscope designed and built by a San Diego, Calif., chauffeur. Its magnification of 17,000 diameters would be sufficient to make the head of a pin appear more than five feet wide. With its aid Dr. Arthur I. Kendall, noted Northwestern University bacteriologist, has observed forms of typhoid germs hitherto invisible. The microscope has six quartz lenses packed in glycerin, uses polarized light, and dispenses with the usual need of staining specimens for observation. R. R. Rife, the inventor, has for years indulged his hobby of microscope-building and germ-raising (P.S.M., June '31, p. 27).

LIFE BUOY SHOT FROM SHIP'S DECK

A new French transatlantic liner, the *Colombia*, is equipped with novel life buoy projectors. Should a passenger fall into the sea, anyone may run to the nearest of these devices and pull a release handle. This electrically fires a cartridge that hurls a life preserver into the water. The device may also be operated electrically from distant stations along the deck by a ship's officer. Light for a night rescue is provided by the life preserver itself, for a capsule attached to it ignites and produces a brilliant calcium flare upon striking the water. When a life buoy projector has been operated, an electric light bulb lights and an alarm bell sounds on the electric deck control nearest the projector, warning the ship's officer of an emergency if they have not already responded to the call of "Man overboard!" The device is the invention of a French engineer at a Saint Nazaire shipyard.

At left, the electrically operated device that shoots a life buoy from liner's deck. Above, an illustration of device in use at sea

Starting with the Next Issue

POPULAR SCIENCE
MONTHLY
Will Give....

A SAMPLE CONTEST PICTURE

1. The forehead of a German who is possibly the most distinguished scientist of our day
2. The eyes and nose of a great statesman who was America's first man of science
3. The most famous airplane in the world on its most famous flight
4. The mouth and chin of America's greatest inventor
You will find it easy to cut this picture along the white lines and assemble the parts with parts of other pictures to form a complete picture of a hero of science and his greatest accomplishment

$10,000 *in Cash Prizes*

AN EXCITING murder mystery becomes most tense and absorbing when you finally seize upon the one telltale clue which leads you step by step to the solution of the riddle. Now you can try your wits in this new picture puzzle contest where *we will give you definite hint, or cue, or clue that* "tips off" every answer needed to get you a big cash prize. If you are sharp and watchful, you can win one or more of 245 money prizes—between $2,000 and $10—and at the same time learn a lot of new things about science and its heroes. Cash prizes will be awarded *each month*, and grand prizes for *six* months the contest will run. There is nothing in the rules to prevent your winning a prize every month, and also a grand prize.

PLAY THIS NEW PICTURE PUZZLE CUT-OUT GAME

Fascinating and Instructive . . . for Every Member of the Family

So simple are the rules of this new contest, that how much money you win will depend only upon sharp wits, watchfulness, and care, and not upon what you know about science. The eagle eyes of your children may compete with your own in solving these instructive picture puzzles.

WHO are these Heroes of Science?

THIS FASCINATING CONTEST will test your ability to take the clues we give you and with them identify famous inventors, explorers, discoverers — pioneers of human progress, and to couple each one up with the invention or event which surrounds his name with world-wide fame. Every picture in the contest will be made up of four parts, each of which belongs in another picture. We tell you enough to lead you quickly to the solution, if you are alert. Then you cut the pictures apart and reassemble the sections in their proper places. For full details see the March issue of POPULAR SCIENCE MONTHLY, published February 2nd, in which the contest begins.

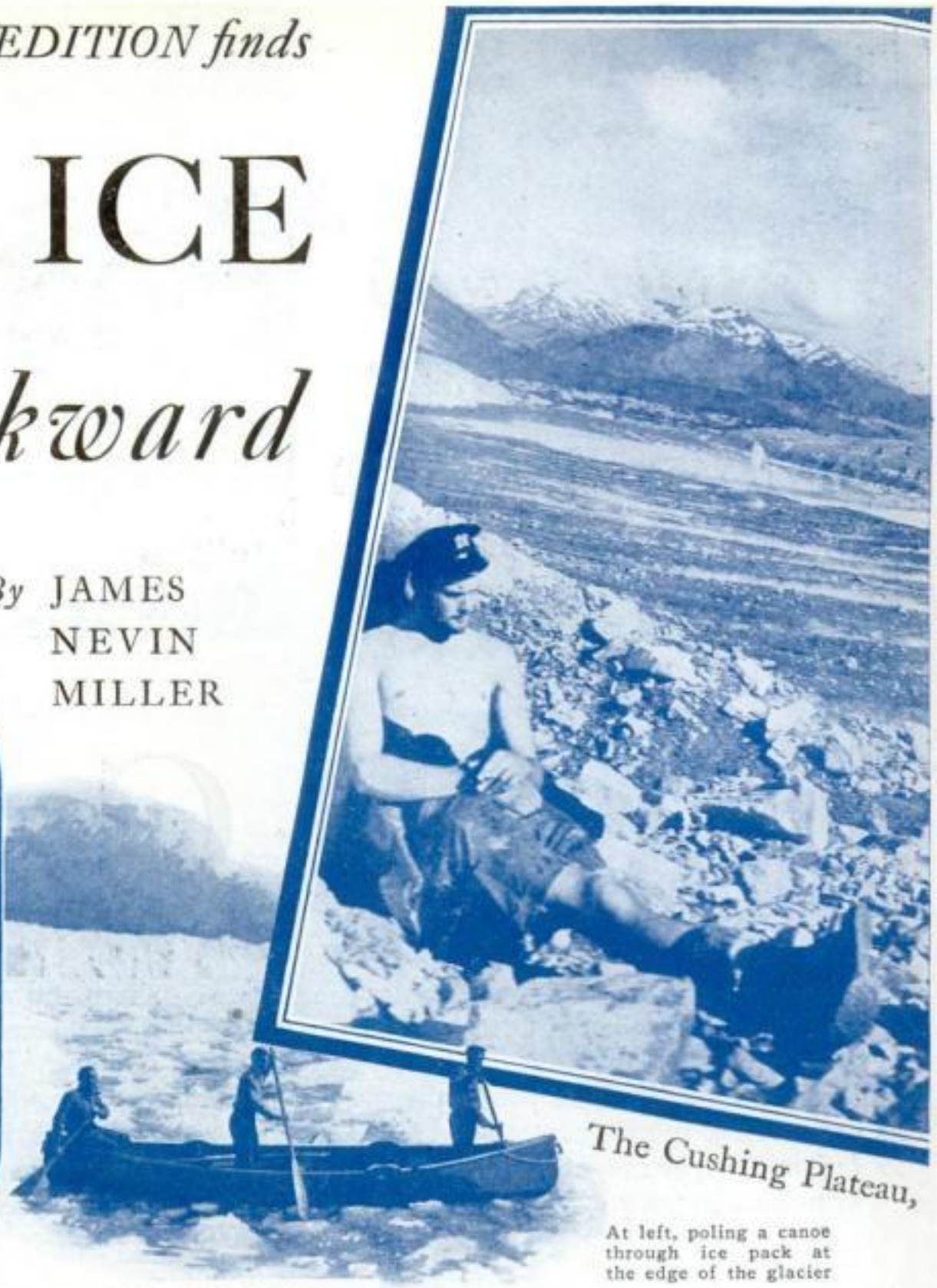
• *Full Details in the March Popular Science Monthly* •

FAR NORTH EXPEDITION finds

River of ICE *Runs Backward*

By JAMES NEVIN MILLER

At left, Dr. H. F. Reid, left, glacier expert of U. S. Geological Survey, with C. W. Wright of Bureau of Mines



The Cushing Plateau, At left, poling a canoe through ice pack at the edge of the glacier

An airplane view of Cushing Plateau ice field which helps feed the mighty Muir Glacier. This plateau is now ten miles long and 500 feet above the sea, half its size twenty-five years ago. This discovery by Wright's expedition proves ice masses are disappearing

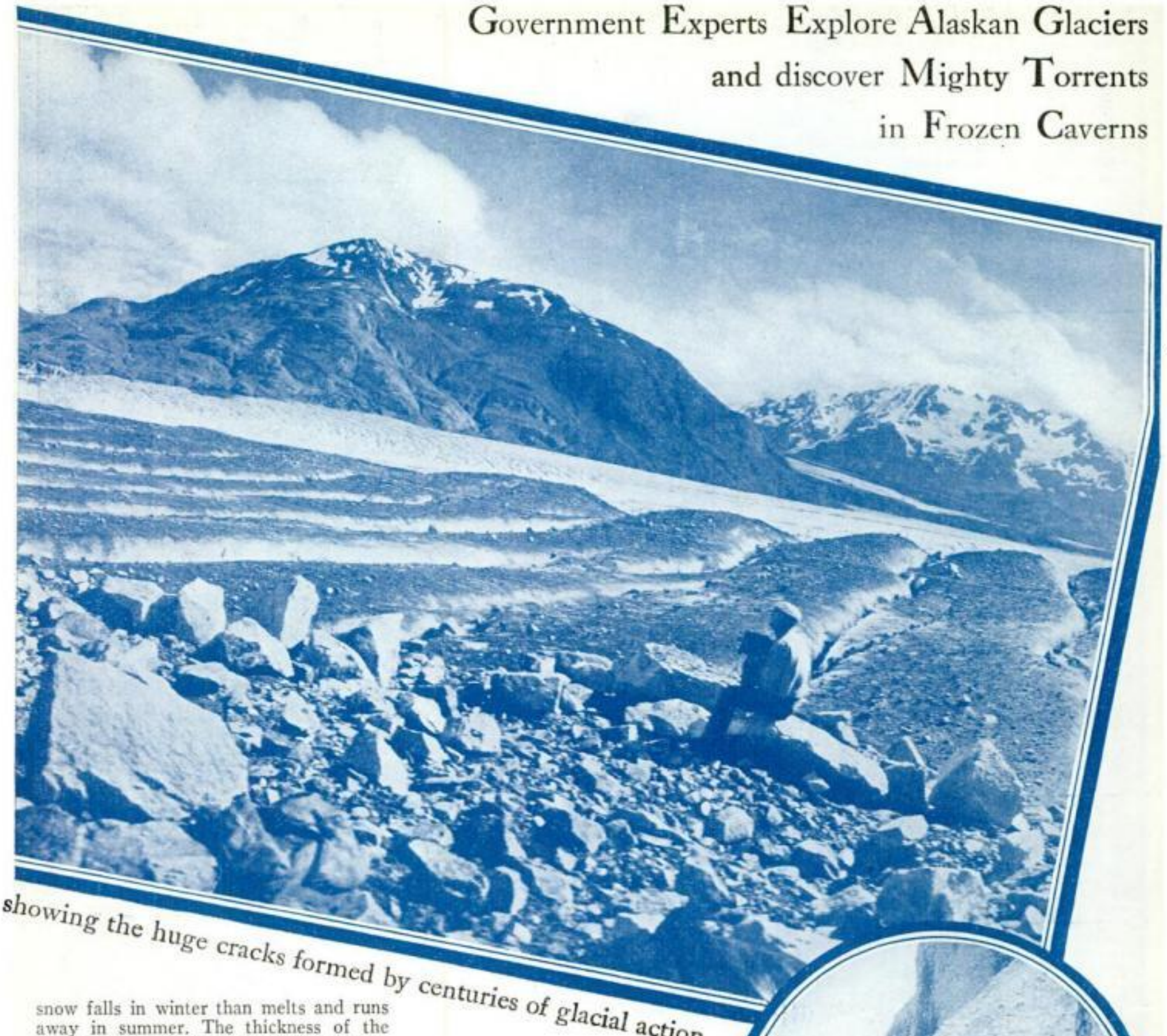
GLACIERS "running in reverse" and invisible rivers foaming through frozen caverns beneath skyscrapers of ice were among the remarkable discoveries made by a party of Government scientists just returned from Alaska.

Led by C. W. Wright, of the U. S. Bureau of Mines, and including Dr. H. F. Reid, glacier expert of the U. S. Geological Survey, the expedition traveled by air, water, and land to study more than 350 square miles of frozen waste. At the upper end of the narrow Alaskan strip which stretches southward along the Pacific for half a thousand miles, like the handle of a frying pan, the scientists made the most complete study of glaciers in recent history, examining a dozen of these mysterious monsters of ice.

At Muir Glacier, they uncovered a surprising fact. Although this glistening white mass creeps continually toward the sea, it has been moving backward, in effect, for the past half century! The measurements taken by the party showed that the glacial front had receded many miles from its position at the time John Muir, the Scottish naturalist, explored the region in 1879. No other glacier in the world, the records indicate, is receding as fast.

An ingenious theory is advanced to explain the phenomenon. Glaciers are born in basin-shaped areas among mountains when more

Government Experts Explore Alaskan Glaciers and discover Mighty Torrents in Frozen Caverns



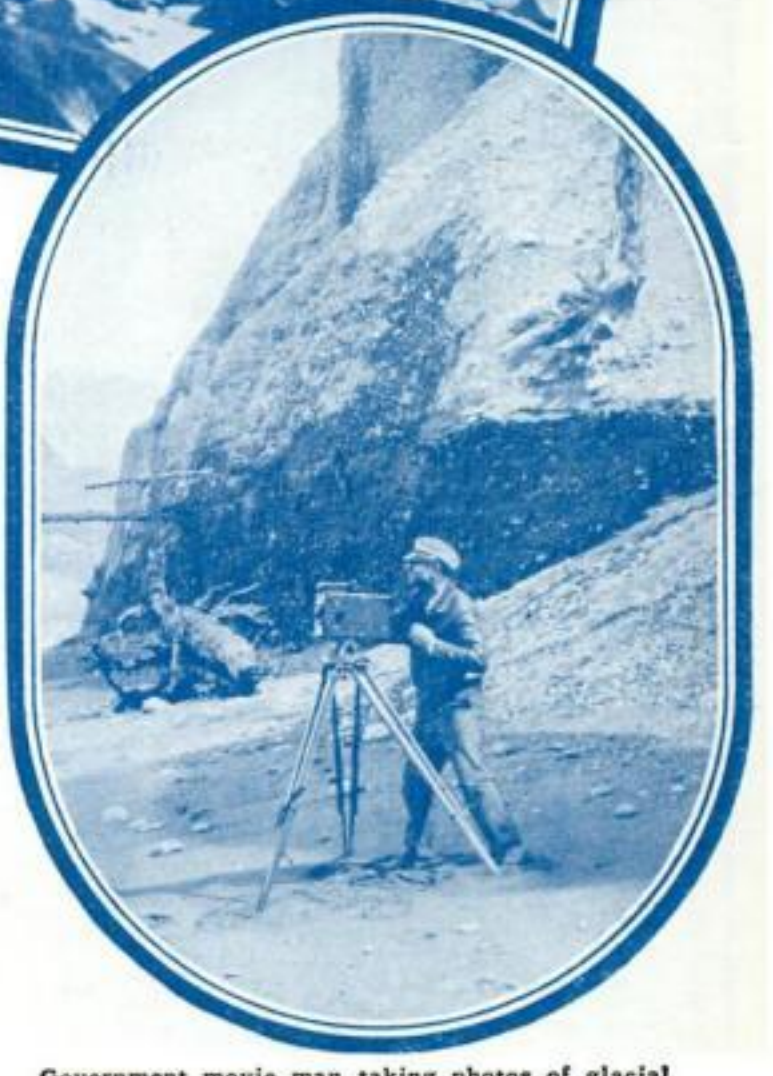
showing the huge cracks formed by centuries of glacial action

snow falls in winter than melts and runs away in summer. The thickness of the frozen mass thus increases until a glacier, or river of ice, forms to drain off the excess. According to the theory, as the snow field is built up, it reduces the temperature of the atmosphere of the area and this in turn results in greater precipitation from storm clouds that drift from the south and west. But the time arrives when the increase in size of the snow field comes to a standstill. Then, gradually, the reverse process begins. The snow field, feeding the glacier, grows smaller, the atmosphere warmer, and the amount of precipitation less. The glacier begins to recede and lose thickness.

AT ONE point on Muir Glacier, measurements indicated that the ice has lost 400 feet in thickness during the past twenty-five years. Mighty rivers, coming from the melting ice, were found pouring through channels cut hundreds of feet below the surface of many glaciers. Receding ice, in a number of places, has revealed mineral deposits, the members of the expedition reported. However, they were in practically inaccessible spots, and most of them were discovered from the air during reconnoitering flights.

The most exciting moment of the trip came when a 120,000-ton mass of ice cracked away from a glacier and crashed into the sea less than 300 yards from the small boat in which the scientists were taking soundings. The sounding launch was nearly swamped and a rowboat, which had just landed some members of the party, was hurled high on the rocks and wrecked. The iceberg disappeared completely under water, then bobbed up and drifted away in the current.

By driving stakes into the surface of a glacier and measuring their changes in position at twenty-six-day intervals, the expedition was able to learn exactly the speed at which these "ice rivers" of the north are flowing. The top speed of the famous European glaciers in the Alps is approximately 120 yards a year. In the Alaskan archipelago, the ice masses were found to be moving ten times as fast.



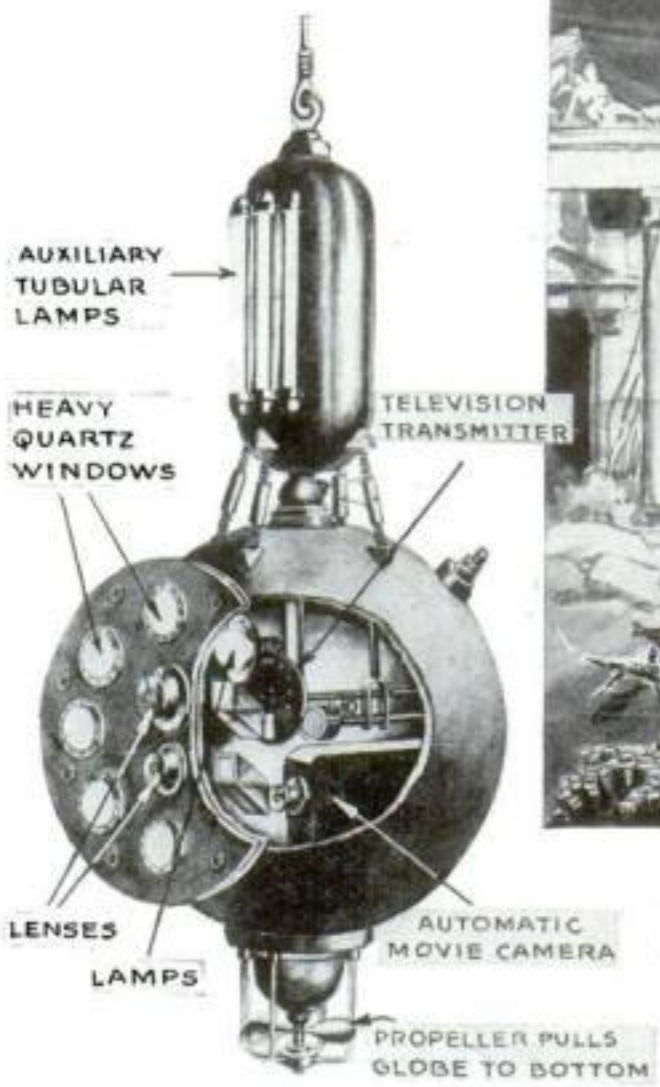
Government movie man taking photos of glacial action which will show the advance of the river of ice. Tree stumps in background were buried beneath the ice pack for thousands of years

TELEVISION TO REVEAL SEA'S FLOOR

WONDERS of the ocean's depths would be made visible to men sitting in the cabin of a ship on the surface by an amazing undersea television transmitter patented by a New York inventor. A water-tight steel globe, equipped with powerful lamps, would house the television machine. The apparatus would be lowered, without an occupant, from a ship. A propeller, run by electric cables from the ship, would pull it downward against its own buoyancy to any depth, so that the valuable apparatus would bob up again if anything went wrong.

Submarine scenes picked up by the automatic television scanner would be transmitted by wire to a screen aboard the boat, or even broadcast over the entire United States. The apparatus could thus be used for educational broadcasts, treasure-hunting, or submarine exploration. Permanent records of scenes of scientific value could be made by a movie camera also contained in the globe.

Dr. H. Hartman, inventor of the device, has also perfected a deep-sea camera with which he has taken submarine photographs for the U. S. Government.



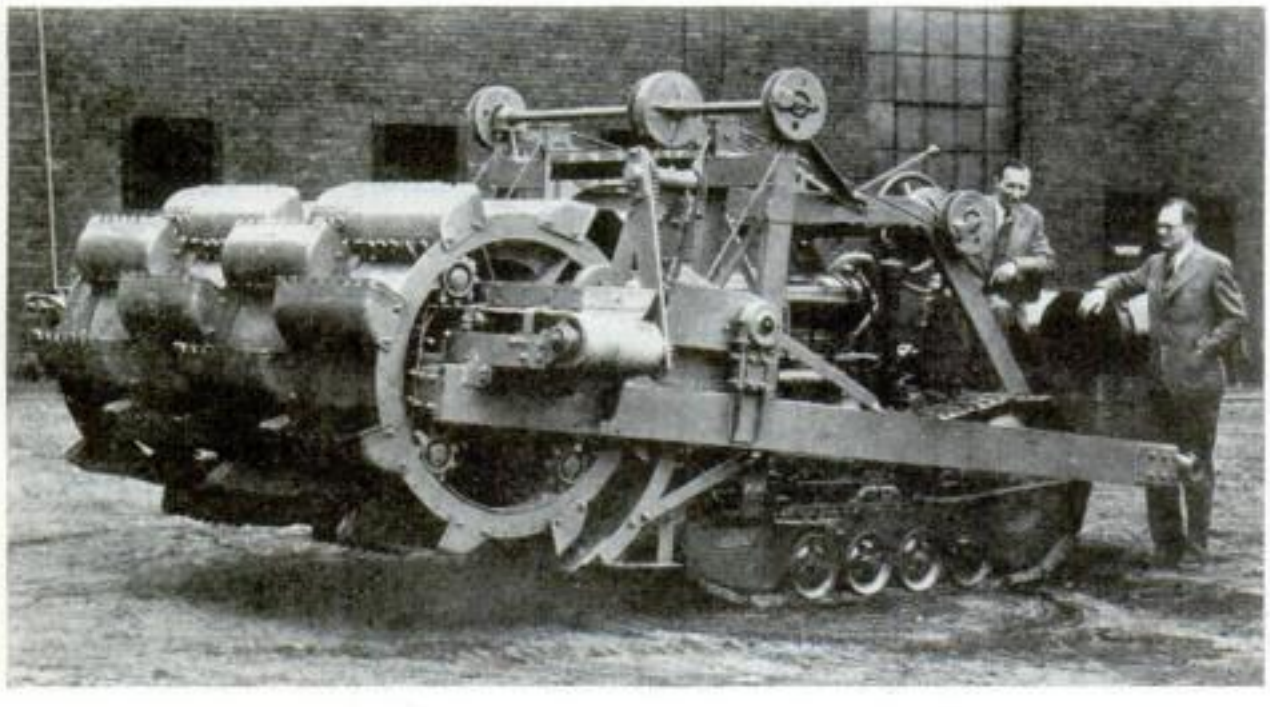
Left, details of proposed television transmitter to study sea's floor. Above, transmitter in globe would reveal submarine secrets

LAMP-POSTS IN CHICAGO LIKE HUMAN FIGURE

UNIQUE lamp-posts, in the form of human figures, were installed recently on an avenue in Chicago. The portly gentleman who is standing atop each pedestal supports a lighting fixture in his hands.

EIGHT-FOOT SWATH CUT BY HIGHWAY GRADER

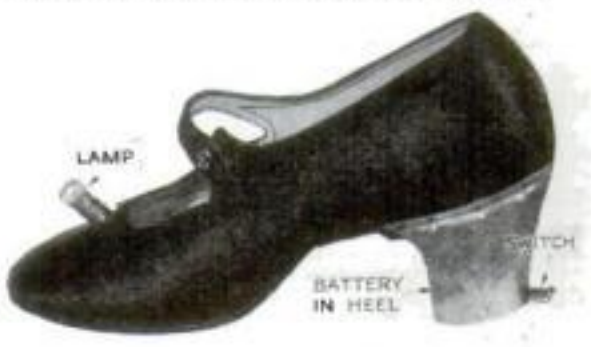
ITS scoops revolving on a huge drum at the front, a new road-grading machine presents a strange appearance upon a highway. The one-man machine works like a mechanical ditch-digger, but cuts a wide, eight-foot swath of shallow depth. It has eight speeds forward.



This new road grader scoops out a swath eight feet wide and has eight speeds, four for digging

BATTERY IN HEEL RUNS LIGHT ON SLIPPER

CREATED originally for a New York theatrical production, illuminated dancing shoes are now on the market. A small bulb on the tip of the shoe is illuminated by a dry cell battery concealed in the aluminum heel. It lights when the dancer kicks the heel on the floor, striking a switch, seen in the photograph below.



GAT LOOSES SPILFSLMILK AT FIRE

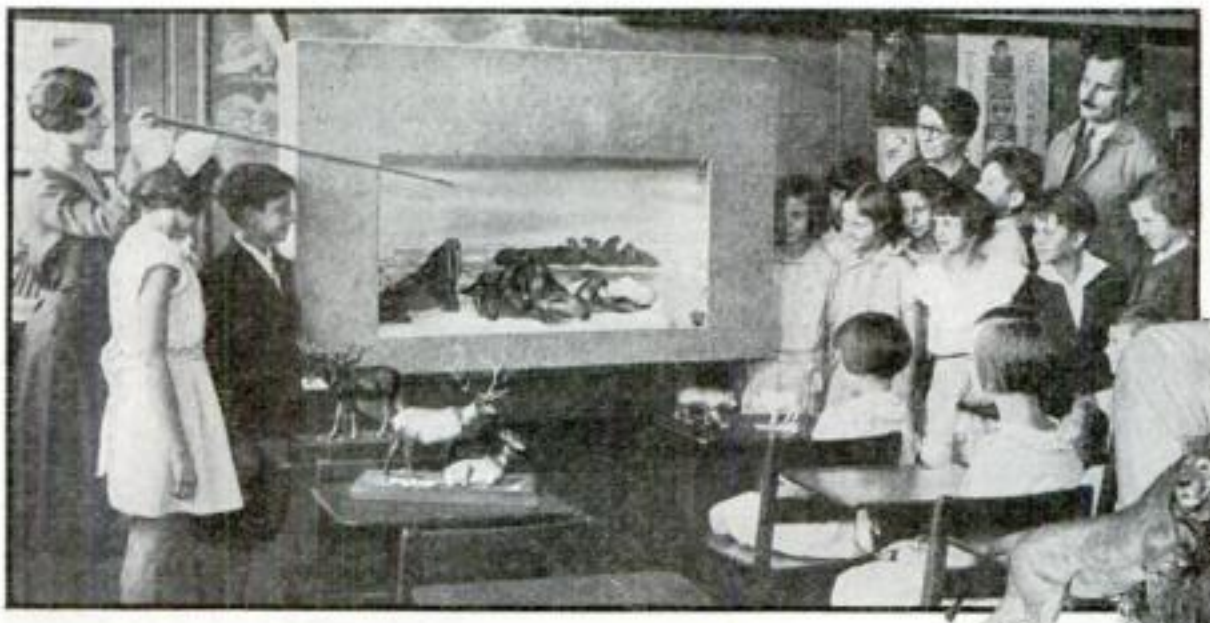
HERE is a Scrambled Headline puzzle that will test your wits.

Suppose a careless printer dropped and pied the type of one of the headlines for a brief news item between pages 44 and 53 of this issue. When he tried to rearrange the headline, all he got was the cryptic phrase above. But someone put the letters back as they should go, as you may see by glancing through these pages.

Can you find the headline that was made from these letters?

Can you form any complete sentences that make sense, using all the letters?

Miniature Exhibits Bring Natural History Museum to Schools



Above, miniature natural history exhibit brings wild animal group to public school with the realism found in museum

Below, experts at work reproducing, in miniature, famous lion group to be used in public schools

No longer need school children waste valuable class time in journeying to natural history museums, for miniature groups now bring the museum to the public school. The small-scale exhibits are prepared by the same men who hunted the animals on the African veldt or in the Arctic, and who have prepared full-sized exhibits for famous American museums; all miniatures are exact copies of the museum groups, faithfully accurate to the smallest detail. Models of animals are illuminated by concealed electric lamps, and a panoramic photograph or painting of the actual scene provides the background. Two leading New York taxidermists, Louis Jonas, associate of the late explorer Carl Akeley in Africa and his brother John, originated the idea, which is hailed as one of the greatest recent advances in educational methods. The first miniature groups are now in use in some of New York's public schools, and the interest manifested by the pupils is said to prove their value.

SPHINX SERVES PATRONS AT GASOLINE STATION

Like water flowing from fountain statuary, gasoline spouts from the mouth of a model Sphinx in London, England. An enterprising owner of a filling station, desiring to attract the attention of passing motorists, had a gasoline pump erected in the form of the famous Egyptian figure. Many drivers have stopped first out of curiosity and became regular patrons.

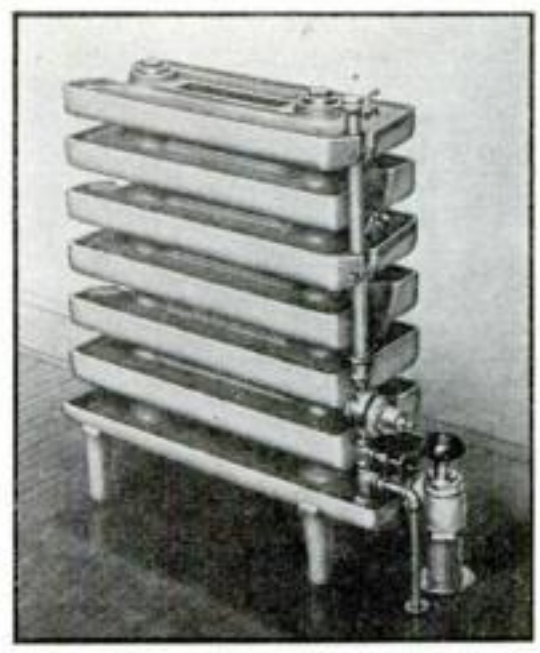
ARTIFICIAL BEESWAX MADE BY CHEMISTS

Artificial beeswax is the latest triumph of chemists in duplicating Nature's processes. The synthetic product is now on the market and, it is said, may be used to replace natural beeswax in creams, ointments, and polishes at a low cost.

HUMPBACKED GIRO HAS FOLDING BLADES

Oddly humpbacked in appearance is a new type of autogiro developed in England. The latest model has a windmill of three folding blades that make it possible to store the machine in an ordinary garage. It seats two passengers, and has a mechanical starter to set the windmill in motion. The humpback, tested in trial flights at Hanworth, England, gave a satisfactory performance. A two-seater open type of folding-blade autogiro also was demonstrated at the same airfield.

HUMIDIFIER KEEPS AIR IN HOME MOIST



A new device known as a humidifying radiator provides the air in a home with the moisture that it needs during the winter months. One of these devices installed in addition to the usual radiators, it is said, will properly humidify an entire dwelling of average size. When connections are made to the steam pipe and to the water supply, hot sections are automatically kept full of water.

SMALLEST PHONE EXCHANGE?

Probably the world's smallest telephone exchange is at Grafton, N. H. It boasts seven subscribers and a little more than a mile of poles and lines. Miss Helen M. Sullivan is the owner, manager, operator, lineman, and makes an annual report to herself.

Secrets of CRIME

True Stories of Real Detectives Whose Amazing Work Beats Sherlock Holmes

By
EDWIN W. TEALE

I HAVE just spent several weeks watching the work of amazing specialists—men who give bullets and guns the third degree.

In the laboratories of these firearms experts, I have seen how every rifle and revolver leaves its "fingerprint" on the lead it fires. Through their high-powered microscopes, I studied the infinitesimal scratches on lead and brass that trap killers.

In their bullet rooms, I examined strange guns: fountain-pen pistols, knife-shaped revolvers, sawed-off gangland shotguns. I heard the frequent crack of pistols firing trial bullets into baskets of waste, and I held in my hand the very slugs that snuffed out lives in some of the most sensational slayings of the decade.

In such surroundings, the bullet-studying criminologist translates microscopic markings on metal into clues that clear up baffling murders.

A speck of rust, a minute island or valley of metal, a scratch on lead a thousandth of an inch deep, a dent in brass too small for the human eye to see, invisible gas deposits in the pores of a hand—upon such trifles, I learned, does the escape or conviction of a desperate criminal often hang.

Witness the strange New Year's Bullet Murder Case in which a bit of buried lead convicted a slayer who had covered up his tracks and even destroyed the weapon he used!

Shortly after eleven o'clock on a night when a dense fog lay over the city, the janitor of a New Jersey apartment house was retiring when he heard loud voices in the hallway above. There followed the crack of a pistol and the sound of running feet. Rushing up the stairs, he found one of the tenants slumped on the floor, dead. Before he could reach the front door, the murderer had disappeared in the white mist.

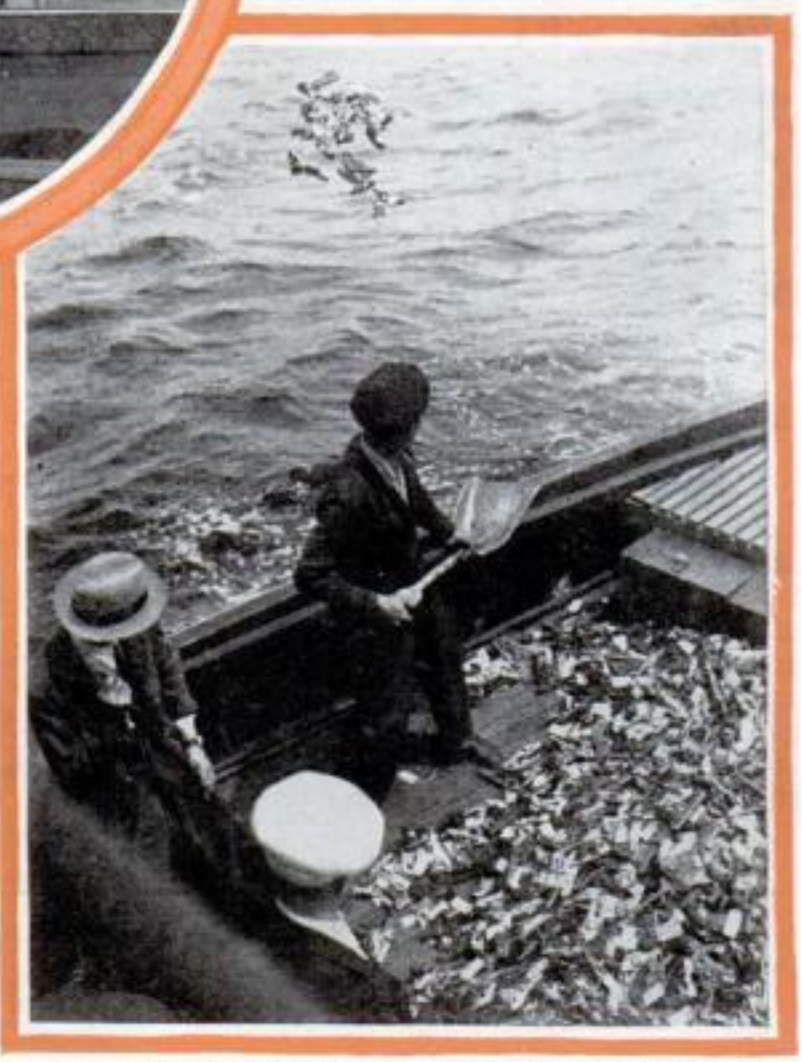
Eighteen hours later, detectives arrested a man boarding a train for the South. He was known to have had a grievance against the victim and, some months before, had been in court for stealing a revolver from a physician. This gun had never been recovered. Police suspected it might be the weapon that fired the fatal bullet. But, unless they could find the revolver, or a bullet known to have been fired from it, it would be impossible to prove their case by comparing the markings left by it with those on the lead taken from the body of the murdered man.

At this stage of the case, one of those strange twists that sometimes come to the aid of a scientific sleuth made the comparison possible. The doctor who had owned the gun recalled that some years before he had celebrated New Year's Eve by firing a shot into the ground from his front porch.

An hour after he had notified the police of this fact, his neighbors were amazed to see officers armed with shovels and screens descend upon his front lawn. Carefully sifting each spadeful of dirt, they recovered the precious bullet and carried it, as though it were a gold nugget, to the laboratory of the firearms expert.

He cleaned away the encrusted shell of dirt and vegetable matter and compared the fine scratches on its side, under his microscope, with those on the fatal lead. They tallied exactly. Although the guilty suspect had destroyed the lethal weapon by hurling it into a roaring factory furnace, the dramatic appearance of the long-buried New Year's

Prof. J. H. Mathews, of the University of Wisconsin, with his apparatus for making photomicrographs of marks on shells



New York police loaded a barge with more than 5,000 weapons taken from crooks of the underworld and at sea off Sandy Hook, N. J., shoveled them overboard to make room at headquarters for more of the confiscated guns

Read on BULLETS .

Col. Calvin Goddard, head of the Scientific Crime Detection Laboratory, in Chicago, examining the inside of the barrel of an automatic with his helixometer, an instrument that enables him to determine pitch of grooves

Luke S. May pointing out the marks made by firing pin found on series of cartridges

In circle, scratches on two bullets from same gun dovetail. Above, how gangsters carry gun

Eve Bullet convicted him of the murder.

In ordinary cases, the expert is given the suspect's weapon with which to shoot trial bullets for purposes of comparison. Deep baskets are filled with loosely-packed cotton waste. Into them, the bullets are fired. They are stopped, undamaged, after penetrating for twelve or fifteen inches.

One of the most famous feats of forensic ballistics, as the study of bullets and firearms is technically called, was Col. Calvin Goddard's tracing of fatal bullets in the atrocious St. Valentine's Day Massacre to the machine gun of the bloody "journeyman murderer," Fred Burke.

ON FEBRUARY 14, 1929, seven members of the Bugs Moran gang of beer runners were lined up against the wall of a Chicago garage and riddled with bullets by rival gunmen. The deadly bits of lead taken from the bodies, and the shells found scattered on the floor of the execution room, were turned over to Col. Goddard. He compared the markings on them with those made by a score of gangland guns, later submitted to him, without finding any that tallied.

Ten months passed. Then, one day, two automobiles collided on a street in St. Joseph, Mich. The resulting argument attracted the attention of a policeman who suggested that both drivers go to headquarters and settle their differences there. At this, one of the drivers jerked a .45 automatic from his pocket and killed the policeman in his tracks, leaped on the running board of a passing car, pressed the gun against the ribs of the man at the wheel, and made his getaway.

Papers in his abandoned automobile showed that he was Fred Burke and led to a search of his home. In a closet, police found a veritable arsenal of machine guns. Col. Goddard tested them in his laboratory. One left markings identical with those on the St. Valentine's bullets, proving Burke was the underworld butcher who operated the machine gun in the Chicago death garage.

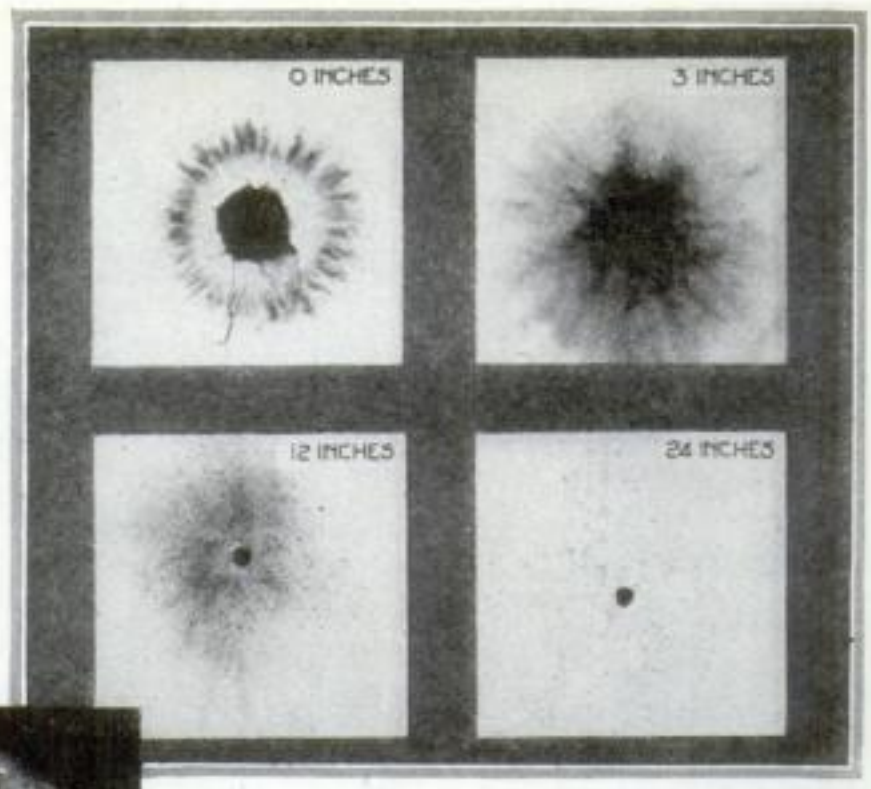
How is anyone able to pick one gun and say: This fired the fatal bullet? At the Scientific Crime Detection Laboratory, in Chicago, Col. Goddard answered that question by showing me how he examined the slugs of the St. Valentine's case. He held out two bullets. One had "F" scratched in the base, the other "T." The first was the fatal bullet, actually employed in the murder, the second a test bullet fired through the gun of a suspect.

AT REGULAR intervals around the sides of each were slanting streaks of fine scratches. They were made, he told me, by the "lands" and "grooves," the spiral rifling in a gun barrel that spins the bullet to keep it on a straight course and prevent it turning end over end after it leaves the muzzle. Fortunately, this grooving is different in different makes of guns. The width of the grooves varies and the number ranges from two to eight. In some guns they turn to the right, in others to the left.

They also vary in "pitch," or the angle at which the grooves are cut. For example, the grooves in a Colt revolver make one complete turn in sixteen inches; those in a Smith and Wesson one in eighteen and three-fourths inches. Col. Goddard employs an elaborate mechanism, the "helixometer," to determine the pitch of a suspect's weapon when it is not known. While the gun barrel slowly revolves, a tiny spotlight on the helixometer follows the rotation of the grooves. On fatal bullets, the pitch of the gun that fired them is determined by studying the angle of the slanting scratches.

Thus, by noting the number of groove marks, their width, pitch, and direction

At left, Col. Goddard pointing out similarities in the markings on bullets as seen in one of his enlarged photomicrographs in which lines are magnified many diameters



Effect of firing gun from varying distances at paper. Results are compared with wound marks

At right, enlarged photograph of the nose of bullet after being fired against screen

of rotation, the expert can tell the make of gun that fired a fatal bullet. Then the delicate, expert work with the microscope begins to determine which of the suspected guns of the make known to have fired the bullet actually was used in the killing.

On little turntables under the two lenses of a comparison microscope, Col. Goddard placed the "fatal" and the "test" bullet. Then he motioned for me to look through the single eyepiece of the instrument. The bullets seemed to overlap. Turning one on its platform until a prominent scratch was uppermost, Col. Goddard slowly revolved the other until a similar scratch appeared.

WHEN I saw the two meeting and forming a continuous line, he began turning the bullets slowly at equal speed, while I watched through the microscope. Tiny scratches, invisible to the naked eye, were magnified a thousand times. At the meeting point, these lines joined each other, dovetailing all around the bullet. Both projectiles bore the "fingerprint" of the same gun. Then Col. Goddard substituted a bullet known to have come from another weapon. Here and there a line matched, but the majority failed to dovetail.

When guns are rifled at the factory, Col. Goddard explained, cutters shaped like knitting hooks are pulled through the barrels to channel out the grooves. "No two cutting edges in the world," he said, "are identical. Under a microscope, they appear saw-toothed with the humps and hollows arranged differently on different cutting edges. Consequently the bottom of the groove that is cut contains microscopic ridges and valleys that leave their mark on every bullet that passes through the barrel."

Moreover, the cutters continually wear away and change, so the markings left on different guns by the same tools are different. Not long ago, at the Springfield Armory, in Massachusetts, bullets were fired through four rifles that had been made one after the other on the same machine. The markings on the bullets were so different that each bullet could be traced to the gun that fired it.

Sometimes, scratches and markings made on bullets *after* they leave the muzzle of the gun prove important in solving crimes. Col. Goddard told me of one instance in which the grooved and flattened side of a .32 caliber bullet showed that the lead had ricocheted from a rock, substantiating a story that a killing had been accidental.

One of the strangest cases on record of unexpected evidence being imprinted on lead occurred not long ago in the South. Two neighboring farmers were bitter enemies. One swore out a warrant for the other, claiming he had fired at him from a distant field. The almost-spent bullet struck him in the stomach, he said, causing a bruise, but did not penetrate the fabric of his coat.

Officials were skeptical, believing he had invented the tale to get his enemy into trouble. However, an expert examined the bullet and found imprinted on the nose a criss-cross pattern that resembled closely the fabric of the man's clothes at the spot where the missile struck. Firing a similar bullet under similar conditions against the fabric, he found the identical pattern imprinted upon it. With the man's strange story thus corroborated by the evidence of the laboratory, his assailant was placed under arrest.

In some cases, the weight of a fatal bullet is of prime importance in solving a murder mystery. For instance, in the Mexican Quarter of Los Angeles, two cousins recently met a third Mexican, who was a sworn enemy of theirs. A fist fight started, the lone man pulled a gun, and one of the cousins started shooting. When the police arrived, one cousin was dead and the others were wounded. Did the dead man die at the hand of the lone man or at the hand of his cousin?

Spencer Moxley, ballistic expert of Los Angeles police, views bullets under glass

THE gun fired by the lone man was a .38 Smith and Wesson; that used by the cousin a .32 Spanish automatic. The fatal bullet, apparently of .38 caliber, had passed clear through the dead man's skull. Probing the path traversed by the bullet, surgeons found a tiny fragment of lead.

The bullets fired in the affray had been turned over to Spencer Moxley, ballistics expert of the Los Angeles Police Department. Moxley weighed each one carefully. All were of normal weight except one, a .38 caliber slug. It was found lighter by exactly the weight of the tiny fragment taken from the victim's skull. Chemical and microscopical analysis of this bullet revealed traces of blood and bone material, linking the fatal lead conclusively to the lone man's gun.

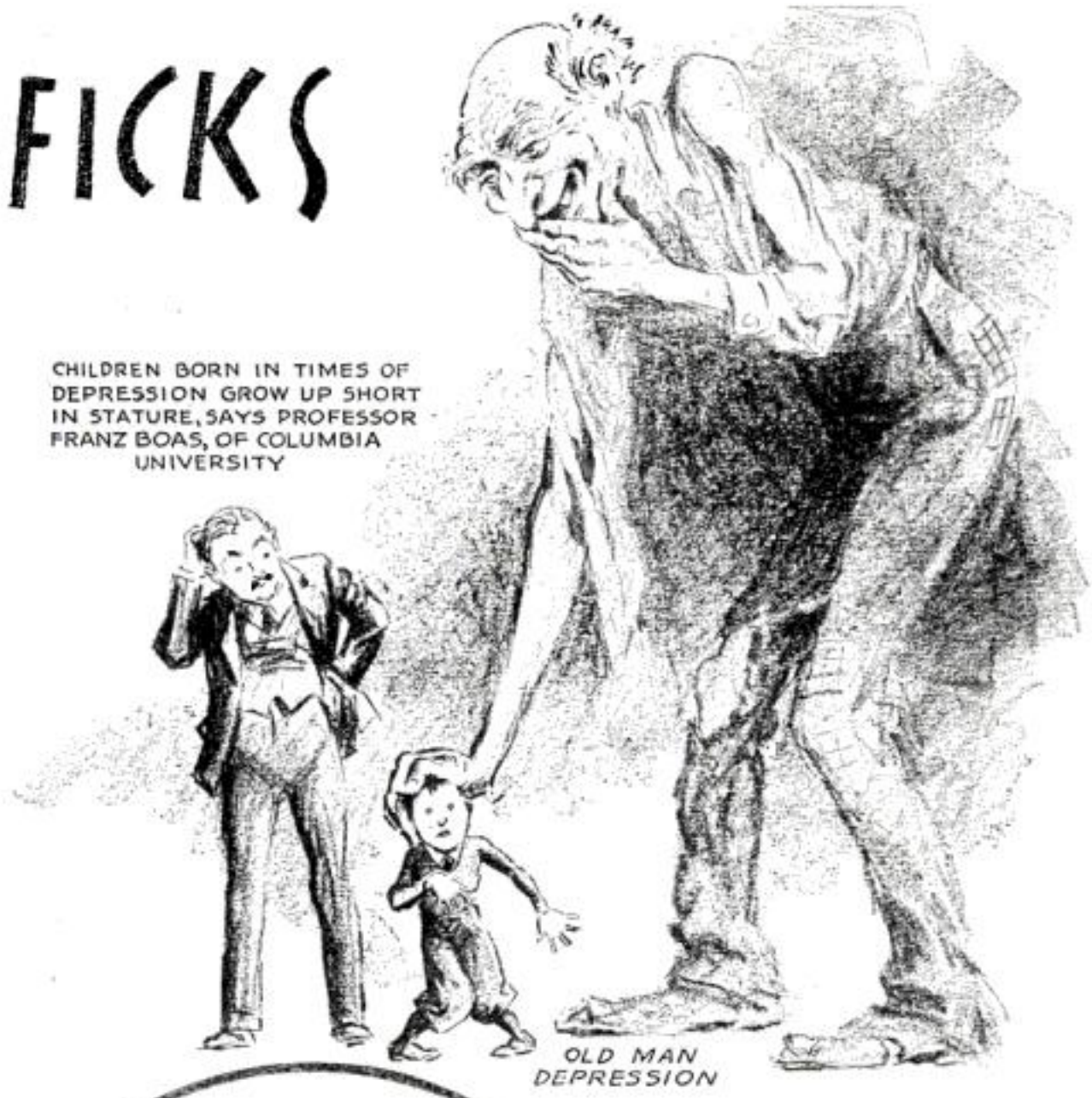
Beating the firearms experts is now one of the first considerations of the underworld. Gangland killers throw away their guns after every murder to prevent identification. In Chicago, steel ball bearings, which carry no telltale markings, have been used in place of lead in several gang slaughters.

Probably the most carefully planned attempt to outwit the skill of the firearms detective *(Continued on page 126)*

SCIENTIFICKS

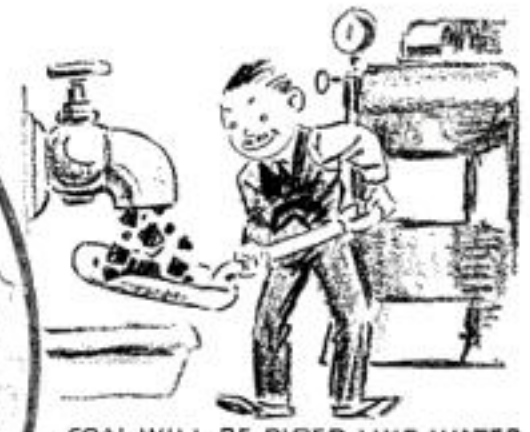
CARNEGIE INSTITUTION ASTRONOMERS HAVE PREPARED A MAP WHICH SHOWS THAT THE MOON HAS A NEW FACE

CHILDREN BORN IN TIMES OF DEPRESSION GROW UP SHORT IN STATURE, SAYS PROFESSOR FRANZ BOAS, OF COLUMBIA UNIVERSITY

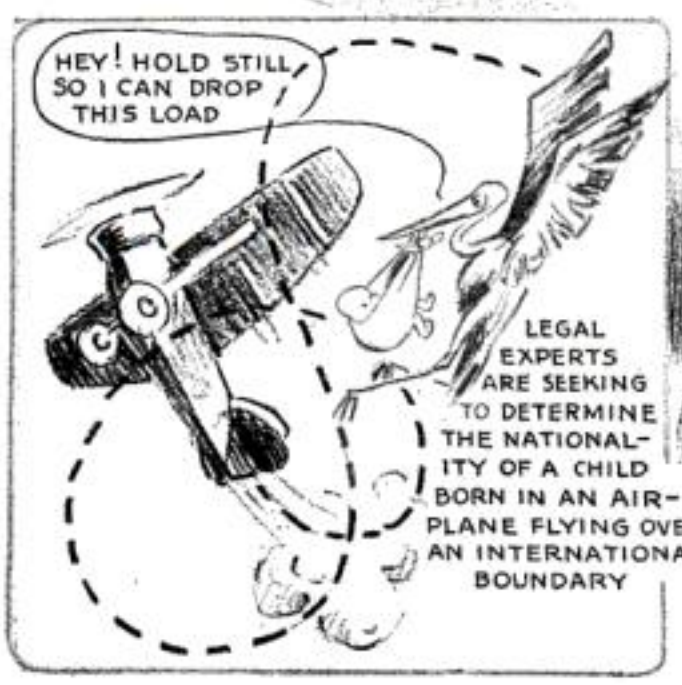


DR. F. E. LAWSON, BRITISH CHEMIST, COMPUTES THAT THE CHEMICAL SUBSTANCES IN ANY MAN'S BODY ARE WORTH ABOUT ONE DOLLAR

DR. FRANZ FISCHER, OF THE KAISER WILHELM INSTITUTE, BERLIN, ANNOUNCES THAT A COAL "COCKTAIL" HAS A STIMULATING EFFECT ON PLANTS



COAL WILL BE PIPED LIKE WATER TO THE HOME OF THE FUTURE, H. E. ROCKEFELLER TOLD THE INTERNATIONAL ACETYLENE ASSOCIATION



LEGAL EXPERTS ARE SEEKING TO DETERMINE THE NATIONALITY OF A CHILD BORN IN AN AIRPLANE FLYING OVER AN INTERNATIONAL BOUNDARY

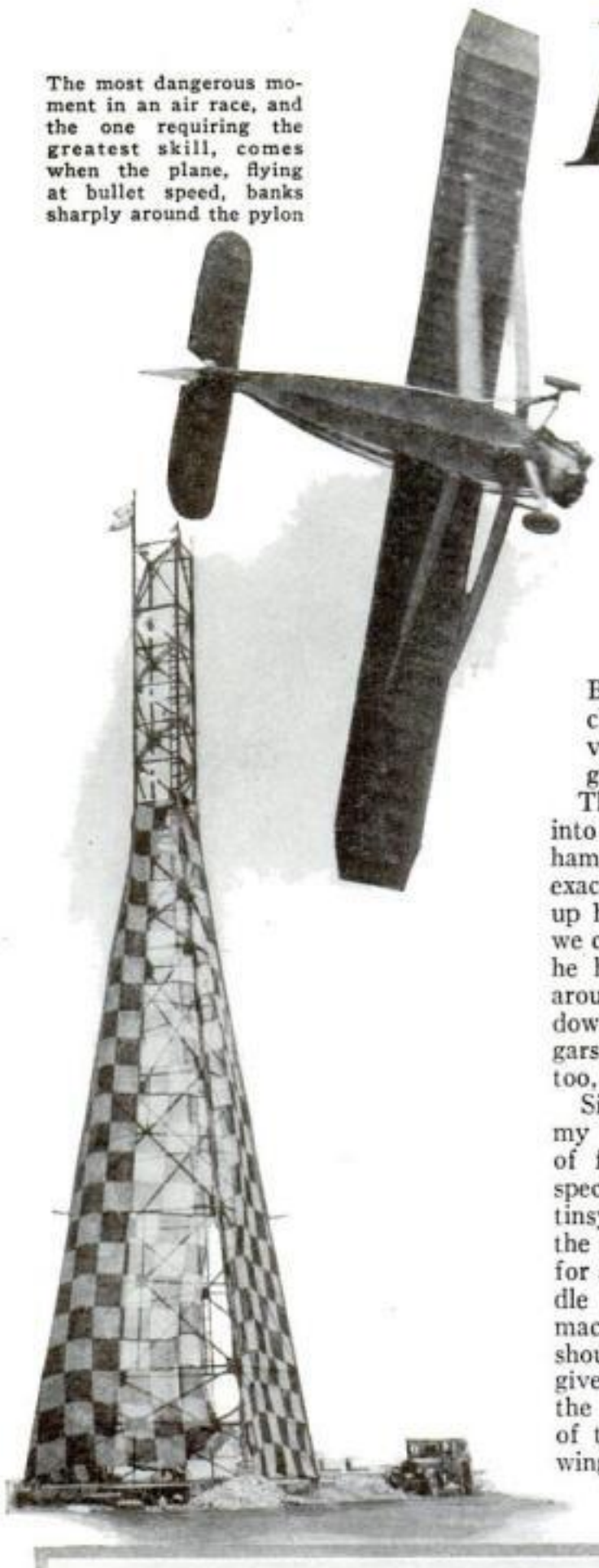
PATIENT LEAVES OMAHA HOSPITAL WITH $15,000 WORTH OF RADIUM IN HIS NOSE

ACCORDING TO DR. RICHARD C. TOLMAN, OF THE CALIFORNIA INSTITUTE OF TECHNOLOGY, THE UNIVERSE IS CONTRACTING AND EXPANDING LIKE A TOY BALLOON

Odd Facts of the Month *as Our Artist Sees Them*

Riding the Wind

The most dangerous moment in an air race, and the one requiring the greatest skill, comes when the plane, flying at bullet speed, banks sharply around the pylon



Famous Racing Pilot Gives Graphic Picture of Thrills and Dangers He Has Met While Flying Planes in World's Fastest Contests

AN AMERICAN racing pilot, who chewed gum as he flew, was one of my early air heroes. He was Walter L. Brock, a young Chicagoan who rode clipped wing Morane monoplanes to victory in three big air races in a single year in England.

That was in 1914. I had just broken into aviation by landing a job at the Grahame-White factory with a salary of exactly nothing a week. Brock took me up half a dozen times. I remember once we circled the course at Hendon just after he had captured the cup in the famous around-London Derby. Before we skimmed down for a landing near the big hangars, I had determined to win that Derby, too, if it took fifty years to do it.

Six years—and the war—passed. Then my big day came when a curious twist of fate placed me at the controls of a specially built three-mile-a-minute Martinsyde racer. The flyer, who was to pilot the ship in the 1920 contest, took it up for a test hop at Brooklands. In the middle of his land run he struck a mowing machine hidden in long grass, hurt his shoulder, and was out of the race. I was given a chance to take his place. So, from the cockpit of a huge, lumbering giant of the air, I switched to that of a tiny, winged streak of lightning.

In *The Scalded Cat* Courtney hit the ground at eighty miles an hour, bounded into the air, crashed down, and turned over with wheels in the air. In spite of that he won the Derby

The racer was later nicknamed *The Scalded Cat* from a description of my take-off in the 200-mile derby. The account of the race which appeared in the flying magazine, *The Aeroplane*, said:

"Next, Captain Courtney, the Irishman from Cork, was flagged away. His machine scuttled along the ground like a scalded cat and shot off across the houses at an amazing pace."

That race at the stick of *The Scalded Cat* was one of the strangest I ever flew. In the rush, I had had little opportunity to test the ship before it was wheeled to the starting line. Soon after the take-off I discovered the pitch of the propeller was too great, overloading the motor. One of the hardest jobs in designing a racing plane is to get the right propeller. Experts sometimes spend days working out mathematically the angle at which the blades should cut into the air. Then a test flight will prove they are all wrong. Only by trial and error, by testing one propeller after another in the air, can the right one, which neither overloads nor underloads the engine, be picked.

TEN minutes from the start, the radiator water began to boil. For 150 miles, I flew by the water temperature gage. Under clouds, where the air is relatively cool, I would push open the throttle and rocket ahead. Bursting out into sunshine, I would have to slow down to keep the water from boiling entirely away.

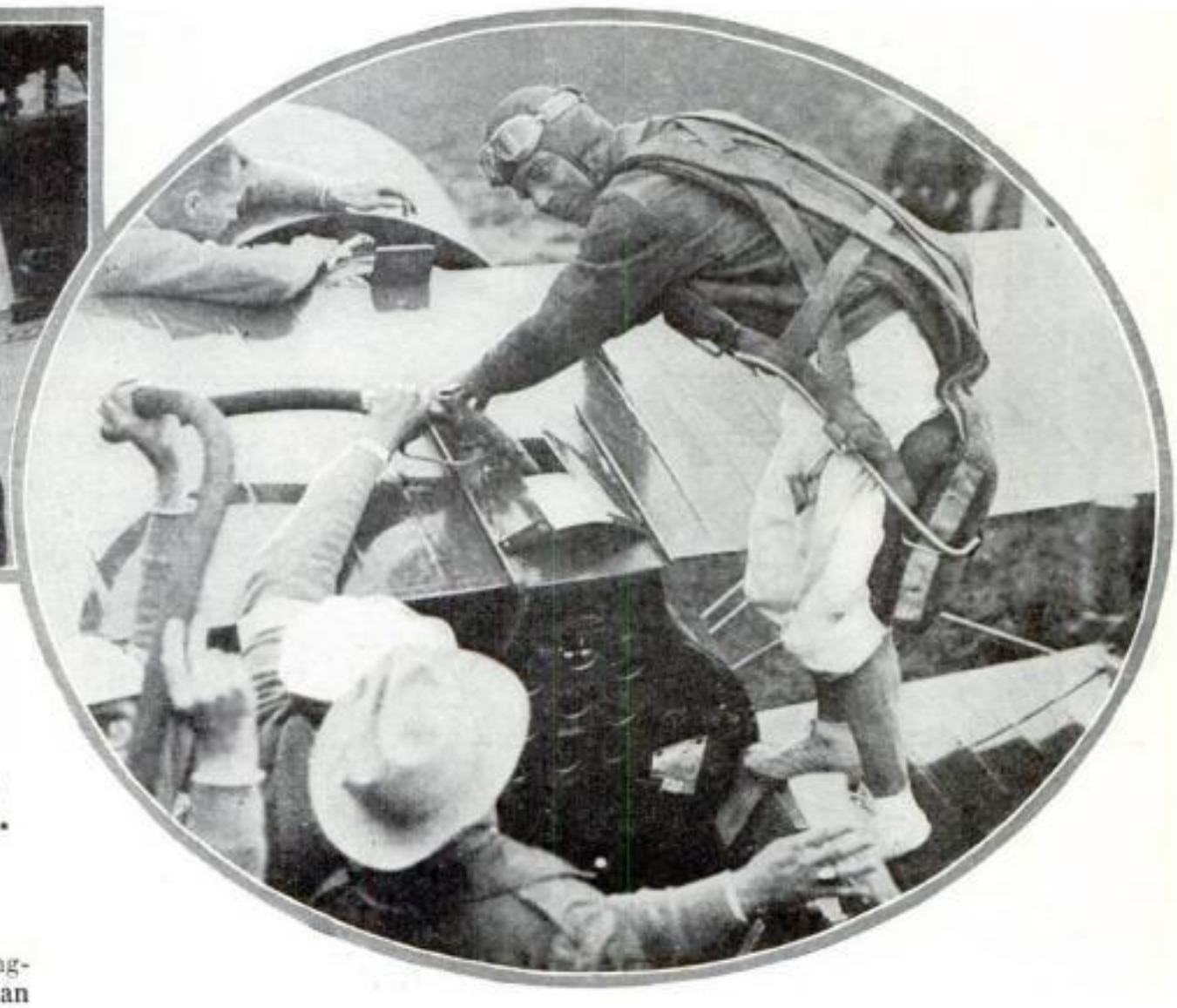
Fortunately, the sky was dotted with clouds and *The Scalded Cat* was the fastest ship in the race. So my average speed kept me ahead of the pack. On the last ten miles, I opened up and let the water boil. Steam streamed back from the radiator. Going nearly 190 miles an hour, I sighted the finish line at Hendon. The radiator was almost dry. I was afraid if I waited to circle the field before landing, the overheated engine would cut out and cause a crash. So half-blinded I came down straight ahead.

The wheels touched rough ground at eighty miles an hour. The landing gear shock absorbers had been adjusted unusually tight. The plane bounded as high as a two-story building, crashed down, bounded again, stalled in mid-air, fell off on one wing tip, cartwheeled onto the nose, and somersaulted upside down with a thud, the landing wheels spinning in the air.

I remember watching curiously an immense white star breaking up into smaller stars like a brilliant display of

in Derbies *of the* Air

Captain Courtney, in cockpit, is congratulated by admiring friends after winning the King's Cup race



Jimmy Doolittle and the plane in which he made his record-breaking flight of eleven hours and sixteen minutes across America. He lowered his average speed by three stops for gas on the way

By

Captain Frank T. Courtney

fireworks. Then I came to. I was hanging by my safety belt, my head less than a foot from the ground. Gasoline was pouring from the tank. The thought of fire flashed through my mind. Instinctively, I flipped back the catch on my belt and—dropped plump on my head, which knocked me out again! When I finally reached the judges' stand to receive the silver cup, my head was still spinning. But—I had won the Derby!

A FEW weeks ago, during the National Air Races, I climbed aboard a crowded airport bus at Cleveland, Ohio. The first person I saw was Walter Brock, still chewing gum. Seventeen years had passed since we rounded the pylons at Hendon with castor oil spitting from the whirling Gnome motor in front of us. One of the biggest thrills I ever had came when he remembered I had not only achieved that early ambition of winning the Derby, but had captured the coveted King's Cup, for the race around England, as well. It has been my good fortune to be the only pilot to win both of these famous events.

In air racing, planes start in five different ways. The old-fashioned racehorse start was the first used. The machines toed a line and began their take-off runs together at a signal from the starter. Such a start is dangerous in a short pylon race because all the ships are bunched together at the first turn, increasing the hazard of collision. In cross-country races, when the direction of the flight is with the wind, the planes have to take off in the opposite direction to face the breeze and then turn. A racehorse start, under such conditions, fills the air with banking planes and adds to the danger of the take-off.

Consequently, a second type of start is most widely used. In it, the ships are flagged away at five- or ten-second intervals, the difference in starting time being taken into account in figuring out the winner.

Another delayed starting system is employed in handicap events. Machines with bigger engines and higher speeds give the others a proportional head start.

A fourth type of getaway is used in the Schneider Cup Race. A contestant can cover the distance of the event any time during the day he chooses. The times are compared and the fastest flight wins. In this contest, planes have to cross the starting line while still on the water. In a fifth kind of start, used in assaults on the world's speed record, the pilot crosses the line in the air.

WHEN Lieut. G. H. Stainforth flashed past Calshot, England, recently at 415 miles an hour, he began his record run high above the water seven miles from the starting line. At full throttle, he flew level while his Supermarine monoplane built up speed from 200 to 250 to 300 miles an hour and beyond. A mile and a half from the judges' stand, he shoved forward the stick and plunged like a blue and silver comet toward the water. He was only 100 feet in the air when the blurred streak of his machine leveled off and he shot away, aiming at a distant cloud formation to keep his course.

In most racing ships, acceleration to the last few miles an hour is slow. By using a diving start, the height of which is set by the officials, a pilot gains quick momentum and saves his engine for the level race against time.

Of all sky races, the most thrilling for spectators and the most dangerous for pilots is a high-speed dash around pylons. Where closely bunched planes bank around turns in a nip-and-tuck battle, only experienced flyers and ships that afford good visibility should be allowed to enter.

AT BOURNEMOUTH, England, several years ago, I entered a light plane race on a Gipsy Moth. A pilot named Longton beat us to the first turn of the five-mile-course and got the inside track. For six laps, I hung on his tail, gaining an inch at a time. Pressing me was another pilot in a tiny one-seater. I feared Longton's ship because, in certain positions, the wing and the motor obstructed his view, increasing the danger of collision.

Near the end of the race, I nosed out Longton and rounded the last pylon, wide open, in the lead. Neck and neck behind me, Longton and the other pilot battled for second place. As I crossed the finish line, I glanced back. Black smoke was pouring toward the sky from a point on the backstretch. Near the turn, the two men had crashed together and the plunging planes had carried both pilots to death.

The next day, an unusual picture, snapped by a news photographer, appeared on the cover of the *London Mirror*. The cameraman had *(Continued on page 123)*

In baby tantrums may originate the inferiority complex. Does this express itself later in the dominating

. . Here *is the* Surprising Truth *about*

The BRUTAL BULLY *and the* Timid Soul

DR. WILLIAM K. GREGORY, distinguished scientist of the American Museum of Natural History, in the first articles of this series, has given the absorbing history of the tiny living speck from which all life arose and sketched its slow development into Man. The manner in which Man passes his characteristics on to his offspring and the functions of the ductless glands were described by Dr. Herbert Ruckes, of the Biological Faculty of the College of the City of New York. Last month, Dr. A. T. Poffenberger, head of the Department of Psychology, Columbia University, New York, told Michel Mok, staff writer, that our emotional life is based upon fear, anger, and love. In this talk, Dr. Poffenberger explains how circumstances and civilization influence and mold our individual emotions; why one man becomes a racketeer and another a useful citizen.

• •

MR. MOK: Dr. Poffenberger, the other day a psychologist said Napoleon defeated the armies of Europe because he had an inferiority complex. What is this complex we hear so much about?

DR. POFFENBERGER: You must not believe everything that is said. According to the theory of your psychologist, Napoleon set out to conquer the world in an effort to rid himself of a feeling of inferiority caused by his short stature of five feet two inches. The trouble with this idea is that there are plenty of little fellows, but few Napoleons. Bonaparte may have started with an inferiority complex, but several other factors entered into his success. Now for an answer to your question: An inferiority complex is the result of interference with a person's urge to self-assertion.

MR. MOK: Will you please explain that?

DR. POFFENBERGER: Presently. First, I want to tell you how to recognize people with an inferiority complex. Roughly, they fall into two classes. They either are day-dreamers or bullies and braggarts.

MR. MOK: How can the same thing show itself in such radically different ways?

DR. POFFENBERGER: An inferiority complex grows from an individual's inability to meet the ordinary situations of life. Every person who suffers from this inability desires to make up for it in some way. The method by which he tries to do this we call compensation. Sometimes, an inferiority complex expresses itself in an utter lack of initiative. The will is almost paralyzed; at best, the individual leads a routine, robotlike existence. In such cases, he compensates by day-dreaming.

MR. MOK: You mean he just sits about, mooning?

DR. POFFENBERGER: Not exactly. Here is a typical example: A humble New York shoestore clerk, on his way to work, stands up in a crowded subway car. Though crushed in the midst of many other passengers, he can yet see a pretty girl seated near by and, directly in front of her, a brutish looking individual hanging on to a strap. As he rides on, our friend feels himself to be a very ordinary person. But, through the back of his mind, there runs this day-dream: "Maybe I seem to be an ordinary man, but I really am a remarkable fellow. I am dressed just like these other people, and naturally they don't realize who and what I am. But just let that brute over there try to annoy that little girl! I spring to the rescue, strike him down, take command of the situation. Everyone asks: 'Who is this?' Then I come into my own!" Our hero wakes up; he has gone six stops beyond his station.

MR. MOK: Don't we all have such day-dreams? I remember, while I was in high school, I used to imagine myself as a successful playwright on the opening night of my masterpiece, with a theater packed by a brilliant audience, shouting: "Author! Author!"

DR. POFFENBERGER: Yes, this kind of make-believe is common among children and adolescents. One boy likes to visualize himself as a victorious general returning, on horseback, from the wars. Another sees himself as a great engineer on the day his giant bridge is opened. A typical young girl's day-dream, especially if she is the daughter of strict parents, is that, some day, it will be revealed that she was a foundling, left on the front step by a passing princess. However, such fantasies persist through adult life mostly in persons with an inferiority complex.

MR. MOK: How about the bully and the braggart?

DR. POFFENBERGER: Bullying and bragging are other ways of compensating for a deep-seated lack of self-esteem. In those cases, the individual raises himself in his own eyes by domineering others, and tries to impress his fellows with his importance by lying about accomplishments he never achieved, or exaggerating what little he did achieve. The man who boasts of his wonderful feats

business man, the artist, or the orator?

At left, Al Capone, who as a general might have rivaled Napoleon, above, if his talents as an organizer and leader had been directed into different channels by the force of circumstances

Another Chapter of Strange Facts in the Fascinating Story of LIFE—*The World's Greatest Mystery*

of daring betrays the fact that he is a coward. But there are subtler forms of boasting; for example, self-deprecation. The chap who exclaims: "What a fool I am!" wants you to disagree with him. He gets angry when you ask him: "Why advertise it?" People with an inferiority complex are likely to indulge their temper, shout, rave, wear loud clothes. Fondness for the limelight and publicity is another symptom. The fellow who crowds into the center of the front row when a group picture is taken has an inferiority complex. So has the grand opera prima donna who throws a fit when she does not get her way. She is unable to meet the ordinary situations of life in a reasonable manner.

MR. MOK: Is there such a thing as a superiority complex?

DR. POFFENBERGER: Cases of so-called superiority complex generally turn out to be cases in which an individual adopts some spectacular method of overcoming his sense of inferiority. The multi-millionaire who makes lavish gifts to colleges may have had little or no education. The hard driver who will not tolerate mistakes by his employes probably was hard driven himself in youth by his parents, his teachers, or his first boss. Or he may have been a conspicuously bad scholar in school. There probably are persons who have a strong sense of superiority, but they show it in conduct indistinguishable from that which marks the man who feels inferior.

MR. MOK: You said that an inferiority complex was the result of interference with a person's urge to self-assertion. What is an urge? Is it the same as an emotion?

DR. POFFENBERGER: Not at all. Last month, I told you that our emotional life is based on three primary emotions—fear, anger, and love (P.S.M., Jan., '32, p. 42). In addition to emotions, we have drives or urges that probably underlie the emotions.

MR. MOK: What do you mean by "underlie"?

DR. POFFENBERGER: You may compare the emotions with the wheels of an automobile, and the drives or urges with the motor that sets the driving wheels in motion. The difference is this: A machine acts only in response to an outside stimulus; for instance, the motor of your car does not begin to function until you step on the starter. If you do not step on it, the automobile will sit quietly in the garage all day. The human or animal organism reacts somewhat in the same way to outside stimuli but, in addition, it also is a self-starting mechanism. In a manner of speaking, it is charged with these drives or urges. An external circumstance may set off this charge but, lacking that, it will go off of its own accord.

MR. MOK: I am afraid I don't quite understand that.

DR. POFFENBERGER: I am sure you will in a minute. Perhaps the strongest of these drives is hunger. When a dog is hungry, and you put a plate of food in its vicinity, it will bound for the plate. Here is the outside stimulus that set off the charge; you stepped on the starter. Suppose you don't feed the dog, and it gets hungry enough, what will it do?

MR. MOK: It will go hunting for food, of course.

DR. POFFENBERGER: Exactly. In that case, the dog is a self-starting mechanism, and hunger was the internal urge or drive that impelled the animal to action.

MR. MOK: If I understand you correctly, you mean that, when a dog fights over a bone, or a baby cries for its milk, the emotion of anger the animal or the child shows is a result of the hunger drive?

DR. POFFENBERGER: Right. That is why I said that the drives or urges underlie the emotions. I told you last month that Dr. John B. Watson, the noted psychologist, proved by experiment that there are only two things that make a newborn baby angry—hunger and restriction of movement. In one case, the emotion of anger is caused by the hunger drive, and in the other by the urge to activity.

MR. MOK: But why does the baby get angry? Is anger the only emotion called forth by these drives?

DR. POFFENBERGER: Not by any means. As I have told you, the organism seems to be charged with these drives and urges. The point is that to discharge them gives satisfaction, and to impede their discharge creates dissatisfaction. That is why the baby is contented when it is given its milk on time and is allowed to move its little arms and legs as it pleases, and why it gets angry when it does not get its bottle

or when the nursemaid pins its arms to its sides. Do you get irritable when you are hungry?

MR. MOK: Irritable isn't the word. I get cross and unreasonable.

DR. POFFENBERGER: So do I. It is the same dissatisfaction created by failure to discharge the hunger drive that causes a baby to cry for its bottle. The difference between us and babies is that, from sad experience, we have learned that yelling for our dinner won't do us any good. Now, this hunger drive has a physical basis. It springs from a lack of certain substances necessary to the body; you might say it has a chemical cause. The thirst drive is a similar case. The animal (or man) is literally driven to seek water by a lack of fluid in the system. There are other drives and urges with a physical origin. The urge to activity, expressing itself in restlessness and a desire for sports and play, probably is based on the body's need to find outlets for physical energy. The need for rest is a drive growing out of the presence of fatigue poisons in the system. With less certainty, but with some degree of plausibility, it may be assumed that there is a physical basis for the so-called sex drive in the presence or absence in the body of certain ingredients—gland secretions, hormones or other chemical matter. Aside from these drives, there are a number of urges that are just as surely part of our make-up, but for which, at present, we can find no physical basis.

MR. MOK: What are they?

DR. POFFENBERGER: Here are a few that you doubtless have observed either in yourself or in others: The need for companionship; the need for friendship; the need for family affection that impels people to establish homes; the need to keep in style. Then, there is the urge mentioned in the beginning of our talk—the need to assert oneself over others; in other words, the urge to self-assertion.

MR. MOK: Would you call these needs and desires drives, like hunger?

DR. POFFENBERGER: Certainly. Some of them may not be as powerful as hunger, but all of them are fundamental urges. They occur in all normal people and affect their behavior. We call them drives because of their impelling nature. They actually drive the individual to express himself in certain ways.

MR. MOK: You said that these urges occur in all normal people. I believe I am a normal person; yet I have no desire whatever to keep in style or be like other people.

DR. POFFENBERGER: Oh, haven't you? Do you wear a straw hat in October, no matter how warm and pleasant the weather? Would you go about in winter in a nice warm suit of animal hides? Why do you and I wear these ridiculous, useless buttons on our coat sleeves? I will tell you why. Because we are slaves of fashion, whether we admit it or not.

MR. MOK: I should have thought that fear of ridicule was at the bottom of it.

DR. POFFENBERGER: All right. But if you were sufficiently lacking in the urge to keep in style, you would not fear this ridicule. Then you would set the style, instead of following it. Now, the average adult human being is chockfull of these drives and urges I have been telling you about. They are penned up in him, like carbon dioxide gas in a bottle of soda water, always ready to bubble over. To discharge them gives him satisfaction.

MR. MOK: Can he?

DR. POFFENBERGER: Not always. Often civilization steps in and says no. Social usage, conventions, morals, proprieties, hem him in on every hand. Civilized society treats the average man much in the manner of the nursemaid who pins the baby's arms to its sides; in other words, it cramps his style.

MR. MOK: What is the result?

DR. POFFENBERGER: The result is he has to express many of his drives and urges in modified or, as the psychoanalysts say, sublimated form.

MR. MOK: That's a big word. What exactly does it mean?

DR. POFFENBERGER: It means that he must hitch his urges onto something that the world approves of. The process of education is essentially one of sublimation; that is to say, it is a method of turning our drives and urges to good account.

MR. MOK: But education does not always succeed in this, does it?

DR. POFFENBERGER: Unfortunately, it does not, but I will come to that in a minute. To make plain what is meant by sublimation, let us take the urge to self-assertion. Primitive man expressed this urge in physical combat. Today, one man beats his fellows at the polls and makes his mark in politics, a second beats his competitors in business, a third distinguishes himself in science or invention, a fourth has an outstanding collection of postage stamps.

MR. MOK: I understand the King of England is a champion stamp collector. Do you mean to say that he expresses his urge to self-assertion in that way?

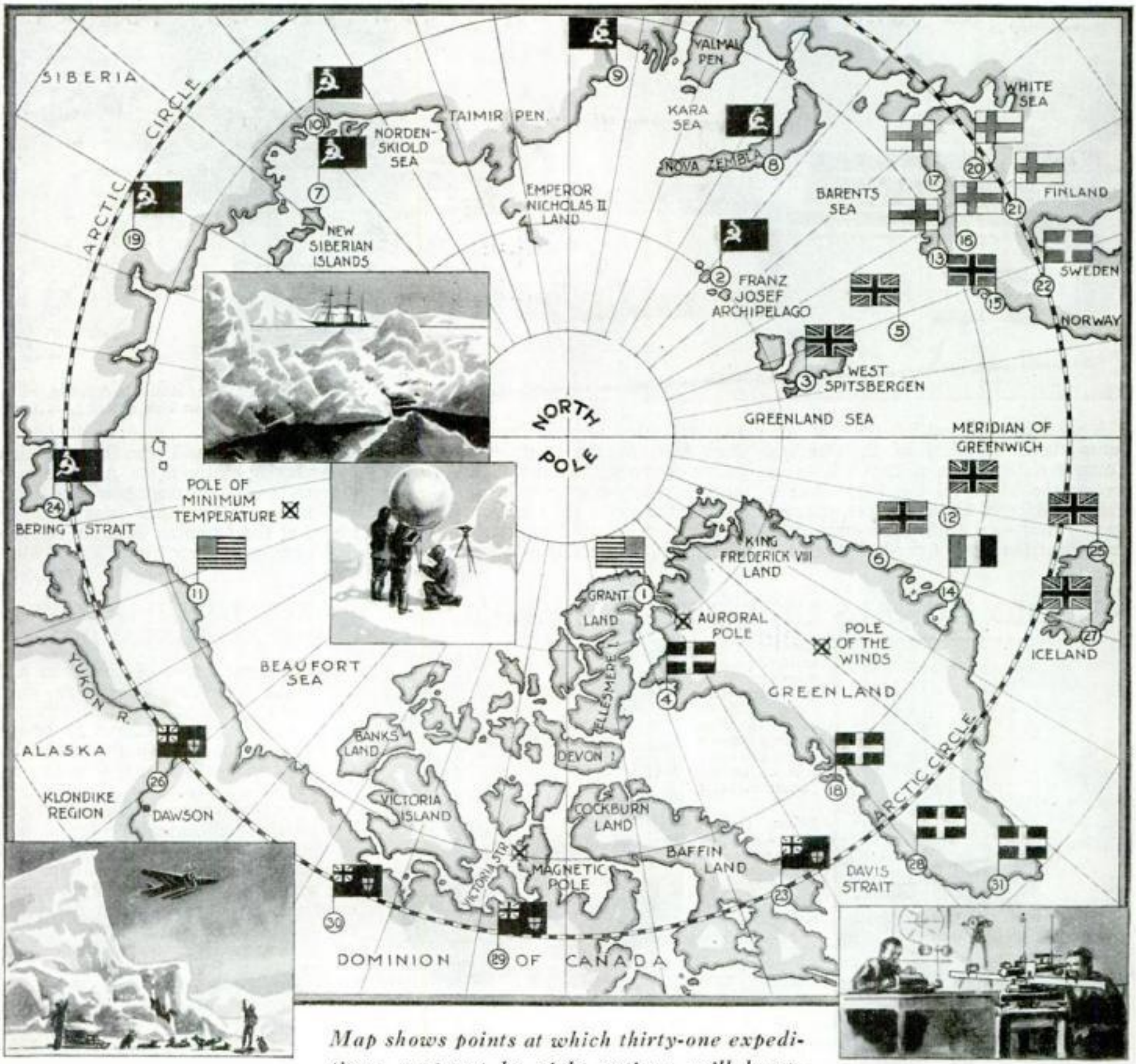
DR. POFFENBERGER: Undoubtedly. What other way has a king nowadays? If he had lived 500 years ago, he probably would have expressed it by going out to fight the King of France or of Scotland. As a matter of fact, the urge to self-assertion is at the bottom of most hobbies, and of almost all competition and contests. In each case, the man asserts himself over others in a manner that has some social value and which, at the same time, gives him personal satisfaction. Dr. Sigmund Freud, the famous Viennese psychologist, and his followers go as far as to say that all poetry, painting, and sculpture is a sublimation of the sex urge; that is, a modified form of expressing it.

MR. MOK: Isn't all modern wooing a sublimation of the sex urge? For instance, if a young man writes his best girl a poem or sends her a bunch of flowers, don't these tokens take the place of the crude methods of his primitive ancestor, who dragged the girl of his choice off to his cave? *(Continued on page 122)*

MACHINES STUDY HUMAN EMOTIONS

Photos show A. P. Link, expert in psychology at Washington Square College of New York University, demonstrating emotional reactions. In laboratory work of this kind many amazing discoveries about the mysterious workings of the mind and emotions have been made. Upon this data psychologists have built a firm foundation for their statements regarding the various complexes and human behavior

31 Expeditions *Invade* Arctic



Map shows points at which thirty-one expeditions, sent out by eight nations, will locate stations to study the climate of the Far North

NATIONS of the world are coöperating during 1932 to celebrate the Golden Jubilee of Arctic exploration. This spring, just half a century after the first meteorological station was established beyond the Arctic Circle, thirty-one expeditions, carrying the latest scientific equipment, will head into the Far North.

Their observatory camps will ring the entire North Polar region. Using squat, thick-walled huts as bases, experts who speak many languages will concentrate their efforts in the common cause of wresting scientific secrets from the frozen upper hub of the earth.

The most elaborate expedition will leave the United States under the command of Capt. Flavel M. Williams, U. S. Naval Reserve. Located at the spot where the northern lights are thought to originate, its camp on Grant Land will be nearer the North Pole than any other base. Here, twenty American scientists will study magnetism, meteorology, geology, astronomy, the action of glaciers, the effect of star radiation, and the relation of radio static to the aurora borealis.

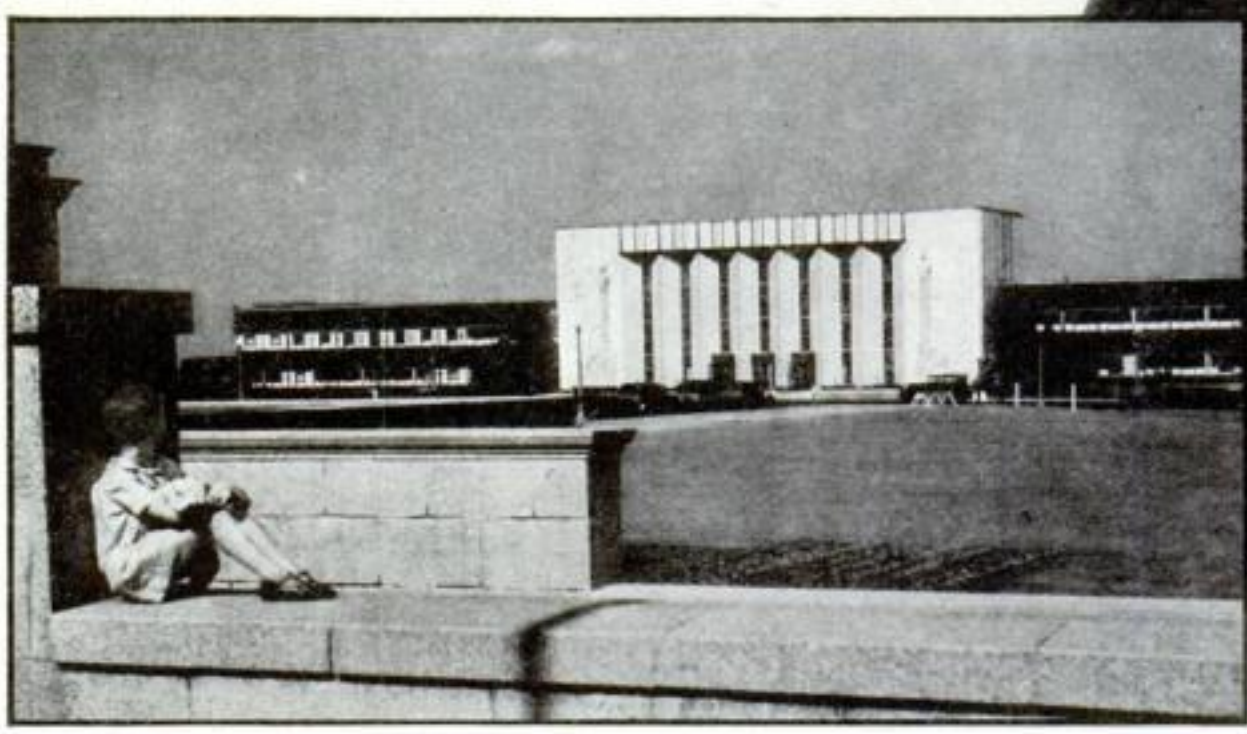
They plan to train their telescopes upon comets invisible at lower latitudes and will test the strange theory of the late Dr. Alfred Wegener, Austrian geologist, that continents drift about on molten rock (P.S.M., Nov. '31, p. 17).

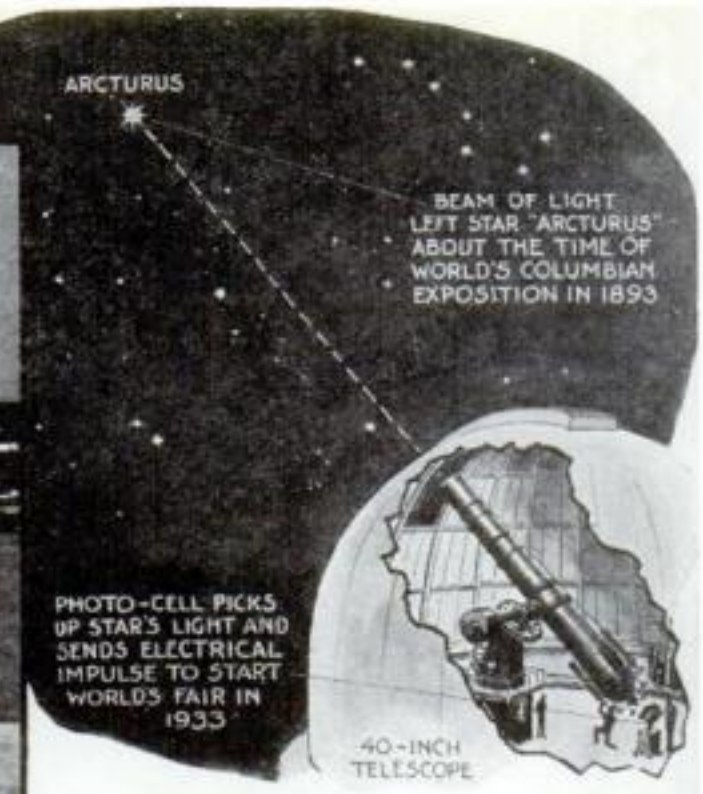
Other nations will be represented by from one to six expeditions in the field. Sweden and France will send out one expedition apiece, Norway will have two, Denmark and Canada four, Finland and England five, and the Soviet Republic seven. A number of additional countries, in various parts of the world, during the year will make special observations in magnetism and other Arctic phenomena.

KEY TO STATIONS ON MAP

1. United States	16. Finland
2. Soviet R.	17. Finland
3. England	18. Denmark
4. Denmark	19. Soviet
5. England	20. Finland
6. Norway	21. Finland
7. Soviet	22. Sweden
8. Soviet	23. Canada
9. Soviet	24. Soviet
10. Soviet	25. England
11. Alaska *(Uncertain) U. S.*	26. Canada
12. England	27. England
13. Finland	28. Denmark
14. France	29. Canada
15. Norway	30. Canada
	31. Denmark

BEAM OF LIGHT FROM DISTANT STAR TO OPEN WORLD'S FAIR





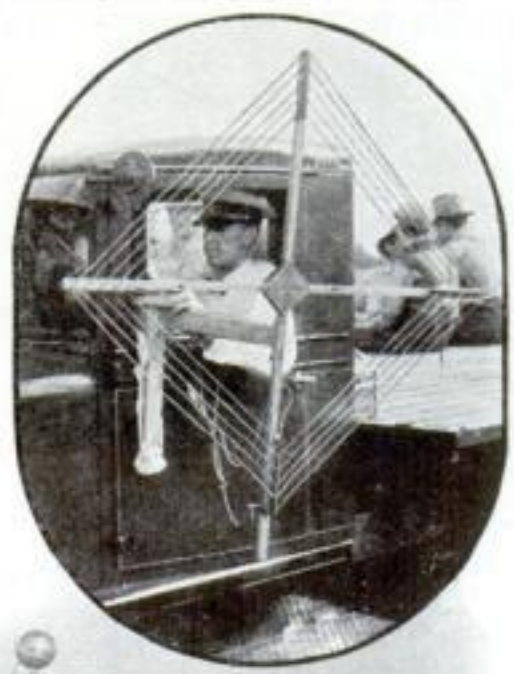
Light from a star, as shown in drawing, will flash impulse to open Fair building, at left

A BEAM of light that left the star Arcturus about the time of the World's Columbian Exposition of 1893 will set in motion the wheels of the 1933 World's Fair at Chicago. Upon the star, approximately forty-one light years away, will be trained the great forty-inch telescope of the Yerkes Observatory at Williams Bay, Wis. At the proper moment the image of the star will be allowed to fall upon a photo-electric cell or "electric eye" at the end of the telescope. This will produce an electric impulse that will be amplified and carried over land wires to Chicago, where it will open the exposition by switching on the lights. A preliminary demonstration showing how the feat would be accomplished was recently staged at the American Museum of Natural History, in New York.

RADIO SIGNALS GUIDE FARMER'S PLOW

Our artist visualizes, left, how a farmer sitting in comfort may plow his fields by radio. This seven-year-old dream has come true on an experimental basis

Below, electrical experts watch radio controlled tractor plow field under guidance of the inventor, right, who governs it



NEARLY seven years ago this magazine prophesied that farmers someday would do their plowing by radio. That prediction has now come true, at least on an experimental scale. Recently, J. J. Lynch, of Miles City, Mont., demonstrated his radio-controlled tractor before 200 electrical experts and business men. Steered from a closed car traveling behind, it plowed around a thirty-acre field. Radio relays beneath the empty driver's seat operated it in response to a radio transmitter in the control car. The experiment brings nearer the dream that "automatic tractors will lumber across the fields and plow with quenchless ardor. The farmer . . . will loll coolly before his radio" (P. S. M., Mar. '25, p. 171).

ARCHITECT HAS GLASS AND ALUMINUM HOME

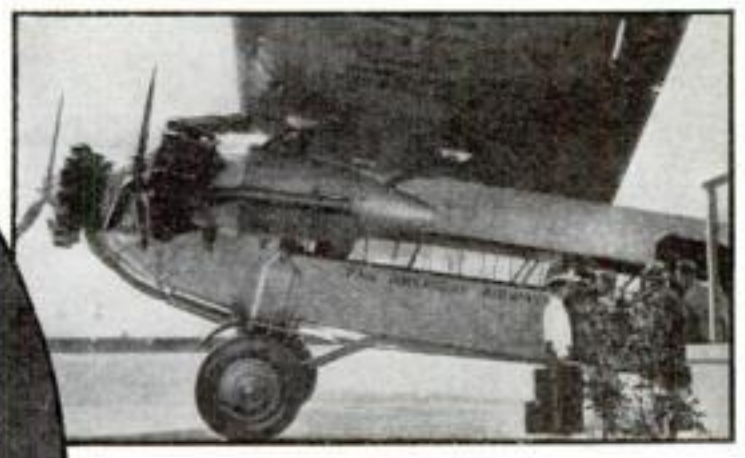
A SUBURBAN home of aluminum and glass, just completed by a New York architect at Syosset, N. Y., to serve as his own residence, is believed to be the only one of the kind in the world. Its singularly modernistic shape follows almost exactly a model of this proposed dwelling which created a stir and caused a great deal of discussion when it was exhibited at a New York architectural show last year (P.S.M., July '31, p. 58). The walls are covered with sheet aluminum, and huge windows run the width of the house to admit sunshine. On the second floor are living room, dining room, kitchenette, and one bedroom, while on the third floor, which has two bedrooms and a closet, there are also a large sleeping porch and a sunny terrace which is used by the children as a playground.

This aluminum and glass home constructed for a New York architect was recently finished

FUR ON NEW RABBIT LOOKS LIKE ERMINE

COSTLY fur coats may soon be imitated at small expense with the pelts of rabbits, through the experiments of Dr. C. F. Friend, Chicago rabbit fancier. He announces that he has successfully bred a new type of rabbit, whose fur closely resembles ermine, shown in the photograph above. Other breeds have also been produced that imitate seal, chinchilla, and beaver, the latter having reached its present development after discovery in France twelve years ago. A by-product would be a plentiful supply of rabbit meat.

MOSQUITOES ARE PASSENGERS ON LONG TEST FLIGHT



At left, collecting mosquitoes for the 1,250-mile test flight in the plane above

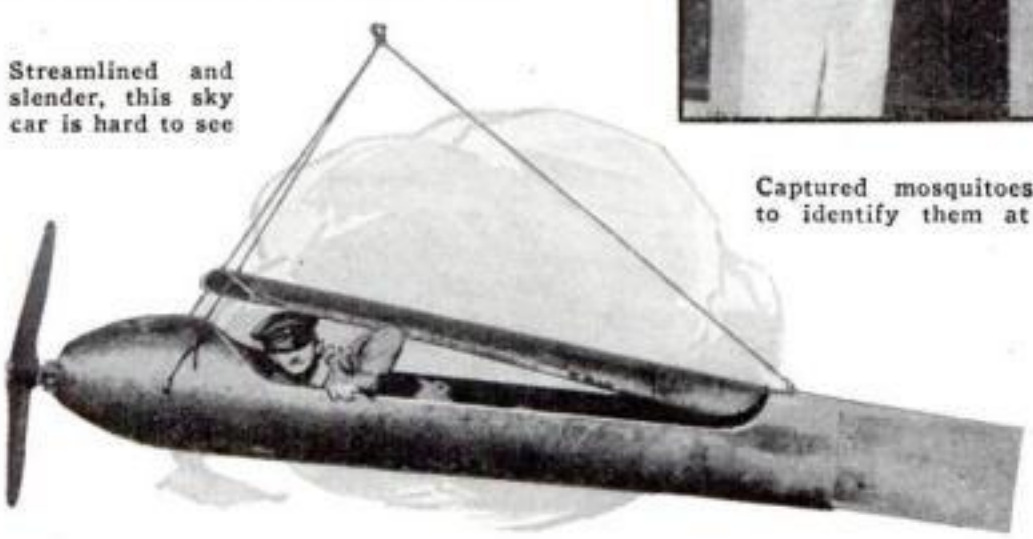
Captured mosquitoes were stained to identify them at journey's end

MOSQUITOES were passengers on an unusual airplane flight from Porto Rico to Miami, Fla., the other day, when the U. S. Health Service set out to discover whether disease-carrying insects were likely to be transported from one country to another by aircraft.

At San Juan, Porto Rico, about thirty mosquitoes were captured with the aid of a novel suction device resembling a vacuum cleaner, designed especially for this delicate work. After being sprayed with an identifying stain from an atomizer, they were released within the cabin of a tri-motored Pan-American Airways plane.

During the 1,250-mile flight to Miami, the presence of the mosquitoes was made evident when one bit the radio operator on the face. Three stops were made en route, and evidently some of the mosquitoes left the plane, for only nine were found when it completed the ten-hour journey. This number, according to the Health Service, proved conclusively that airplanes carrying insects might conceivably start an epidemic.

Streamlined and slender, this sky car is hard to see



NEW OBSERVATION CAR FOR AIRSHIP

NICKNAMED the "flying fish," a new type of observation car for airships has been constructed by a Viennese engineer. Like the "sky car," used occasionally by United States airships, it may be lowered on a cable through the clouds while the airship is in flight. The Viennese invention, however, has its own propeller, enabling the observer to maneuver his gondola. The fishlike tail is flexible and may be swung from side to side, serving as a rudder. Because of its slender, streamlined shape, the gondola is invisible from the earth at comparatively low altitudes.

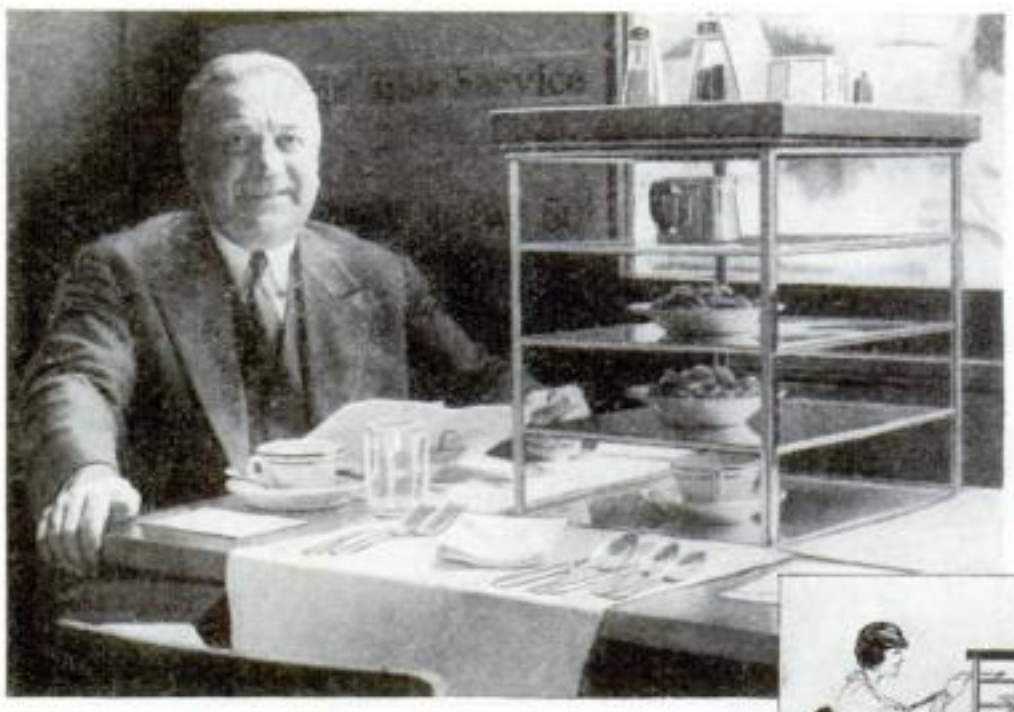
ALUMINUM HYDRANT SHINES

FIREMEN lose no time in finding a new hydrant, equipped with reflecting facets of polished aluminum that gleam in the dark under the rays of an auto headlight.

BIG MONSTERS IN PARADE

MONSTER animals, inflated with helium gas, are being turned out by an Akron, O., factory for department stores to use in advertising their wares. A few weeks ago some of these creatures paraded in Boston, as shown at left. Released, they soar away. Clarence Chamberlin, noted aviator, recently won a store's prize by returning a fragment of such a balloon snared in flight.

MAGIC TABLE SERVES DINERS IN RESTAURANT



At left, magic table upon which food appears as ordered without help of a waiter

Below, drawing to show how order is received in kitchen, filled, and sent on lift to diners

MAGIC tables in a Worcester, Mass., hotel now serve meals to patrons without the assistance of waiters. When a guest sits down to eat, he notes his choices on a menu and drops it through a slot to the kitchen below. Presently a dumbwaiter rises through the center of the table bearing the dishes he has chosen, and the check. The mechanical waiter need not be tipped.

According to the inventor of the novel system, food may thus be served at cafeteria prices, while the patrons are not obliged to carry trays nor to sit at an uncomfortable lunch counter. Dining in privacy, they enjoy the saving in cost that the mechanical service allows. This is the first actual installation of the system which was devised about three years ago (P.S.M., Apr. '28, p. 62).

TYPEWRITER AND TOILET ARTICLES IN ONE CASE

A BOON to the professional man or woman who travels is a utility case that not only contains a portable typewriter and writing supplies but most of the toilet articles and other things that are likely to be needed on a trip. Despite its all-purpose usefulness, the compact outfit is little larger than a typewriter case.

GUESSER GETS WEATHER RIGHT

Dr. C. F. Marvin, head of the U. S. Weather Bureau, using the "weather guesser" he devised

WHILE day-to-day weather forecasting enjoys reasonable accuracy, meteorologists have still to work out a basis for long-range prophecies. Nevertheless, Dr. C. F. Marvin, head of the U. S. Weather Bureau, is experimenting with a "scientific guesser." Small balls are marked for a certain kind of weather. The balls are thoroughly mixed and poured into troughs. Their sequence, depending solely upon laws of chance, has proved strikingly similar to actual weather records.

LIGHT KNEE REST HOLDS BOOK OR MAGAZINE

READING is made painless for the most comfort-loving of mortals by a new book rest that clamps lightly over the reader's knee. It not only supports the book's weight but holds it open and keeps the place. Extension arms unfold to hold a magazine or a sheet of music. The user, sitting in an easy-chair, has both hands free to make notes, smoke, or eat.

NEW CHART TESTS EYEGLASSES FOR READING AND BRIDGE

WHEN a novel eye chart devised by a New York firm is laid on a table, in front of a customer, it gives a more practical test of his new glasses than does the conventional array of scrambled letters. Since persons ask most frequently whether they will be able to read a telephone book, a newspaper, or a sheet of music, the chart combines life-sized specimens of these forms of printing. It also provides samples of playing cards so that the bridge enthusiast may be sure the glasses will provide against missing any trick in the hand. Placed across a table, it will show whether the dummy will be plainly visible.

At the left is shown a reproduction of the new eye-testing chart, reduced in size.

ANTIRATTLER FOR CAR

RATTLES and squeaks in your car's doors are stopped, it is said, by the use of a new type of antirattler containing a small but powerful coil spring. When two of these devices are installed between each door and its jamb, as at the right, they maintain a constant tension that holds the door firmly against the lock.

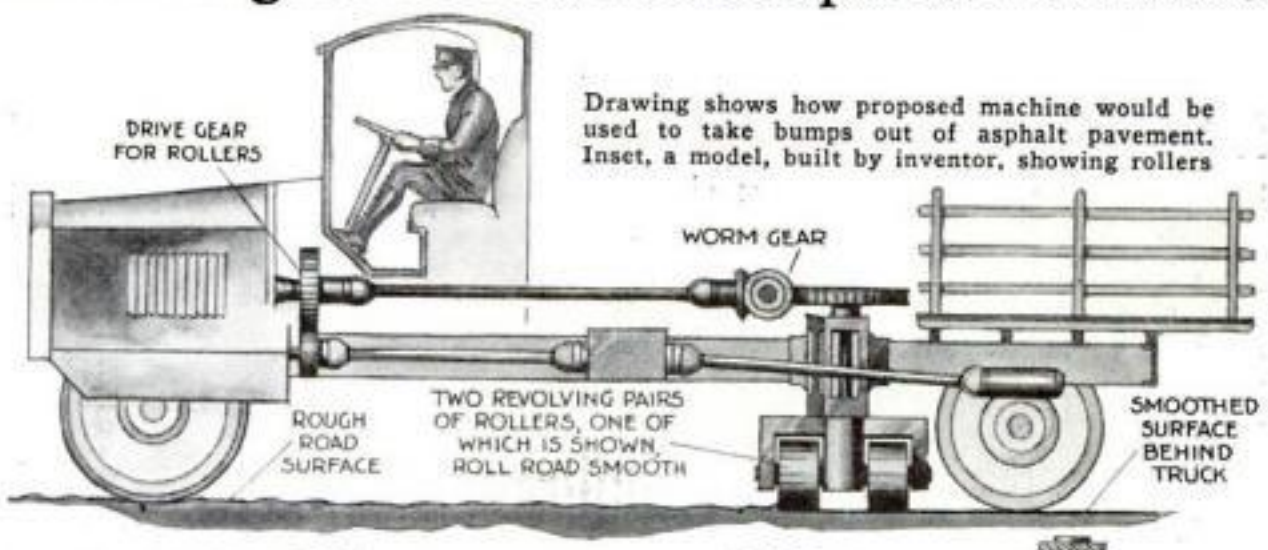
AIRPLANE-SHAPED KITE MADE OF ALUMINUM

A NEW style in kites is set by this all-metal model patterned after an airplane. With a string tied to its "fuselage" and a strip of cloth added to serve as a tail, it soars high enough to delight any youthful kite flyer. Less fragile than paper or cloth models, the fifteen-inch toy is made of aluminum and looks real in the air.

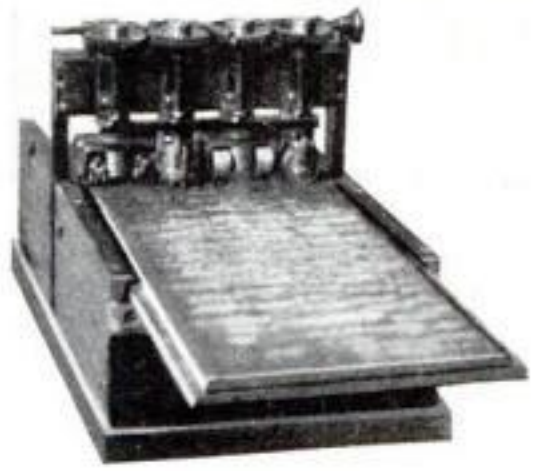
DRIVE SHAFT SPRINGS START CAR QUICKLY

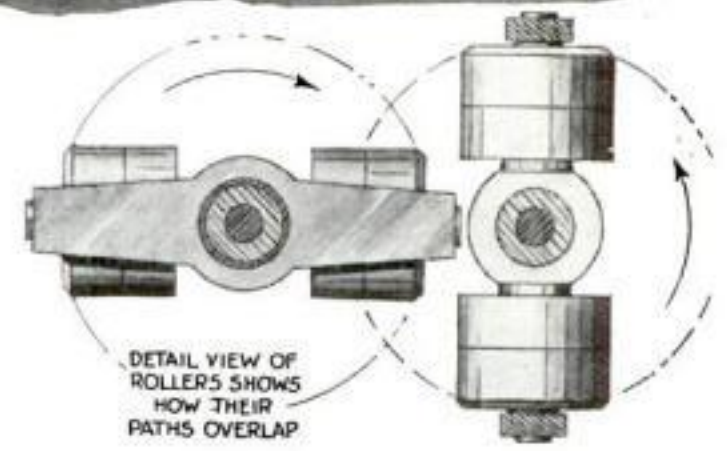
THE energy needed to stop a car, as for a red traffic light, is harnessed in a new traffic booster with the result that an amazingly fast getaway is possible. This simple device, the invention of a California man, substitutes a special drive shaft and housing for the one on the car. When the brake pedal is depressed slightly, powerful springs in the new shaft are wound up, acting as an effective brake. As soon as the brake is released, the springs unwind, and their power applied to the wheels makes the car leap ahead without the necessity of shifting gears. Through an ingenious gearing system, the direction of the unwinding springs' impulse is forward and not in reverse.

Revolving Rollers Smooth Asphalt Pavement



Drawing shows how proposed machine would be used to take bumps out of asphalt pavement. Inset, a model, built by inventor, showing rollers





MASSAGING pavements to take the bumps out of them is the cure proposed by a western inventor for washboard highways of asphalt. Recently he patented a machine mounted on a truck body, in which two pairs of revolving rollers whirl around as the truck progresses, leveling the corrugations of the road surface. If the road is too badly ridged by heavy traffic for this treatment, other rollers may first be used which will pulverize and cut down the high spots. With the aid of such a machine, the inventor declares, a highway may be kept in good repair at a minimum of expense and new construction is unnecessary.

STEERING WHEEL ON SPRINGS

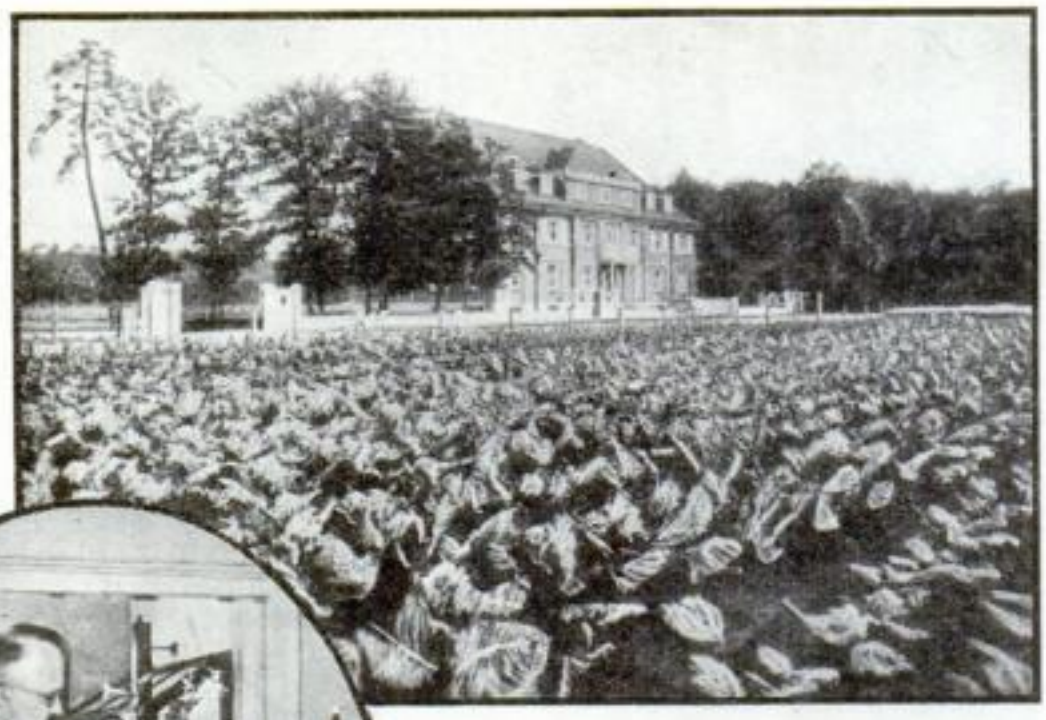
AN INNOVATION in riding comfort appears in a new British car, in which the steering wheel is mounted on springs. These replace the usual spokes, and prevent the transmission of continual road shocks to the driver's hands. The springs are sufficiently strong to permit no loss in the control which the driver has over the car, even in making a sharp turn. On long drives it reduces fatigue.

At right, demonstrating a French pistol that fires carbon dioxide "snow" which, striking at the base of a fire, smothers it. The small extinguisher is expected to reduce water damage

PISTOL FIRES GAS TO KILL FLAMES

A PISTOL that puts out fires was demonstrated recently to French officials. Pulling the trigger releases a stream of carbon dioxide "snow" from a reservoir. When the flakes are directed at the base of a flame, they smother it with gas. Pistol extinguishers of this type may be used in homes and factories, and are especially valuable where streams of water might damage valuable furnishings or products.

NEW TOBACCO PLANT HAS NO NICOTINE

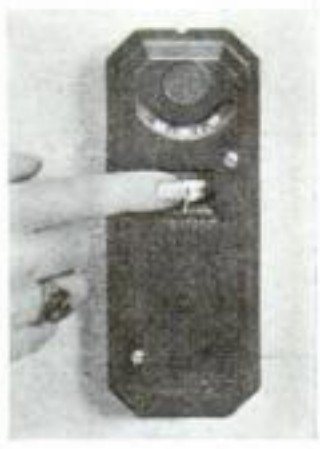


At right, field of German-grown tobacco that contains no nicotine. The plant was produced after five years of effort in a research institute headed by Dr. Paul König, in oval

TOBACCO minus nicotine is produced from the leaves of a remarkable plant raised in Germany. This botanical freak is the reward of experiments conducted under the direction of the Ministry of National Economics, at a research institute established in the midst of the tobacco-growing fields of Pfalz. Although an extract from the leaves is virtually as harmless as drinking water, the "smokes" made from the plant are said to have all the flavor of ordinary tobacco.

An unexpected by-product of the experiment was the discovery that the leaves could also be used to prepare a succulent salad. As if that were not enough, the salad may be flavored with oil extracted from the same plant, according to Dr. Paul König, director of the institute.

MACHINE AUTOMATICALLY CONTROLS HUMIDITY



JUST as a thermostat regulates temperature, so a new "hygrostat" has now been invented that automatically controls the humidity of the air in a room. The instrument operates as an electric switch, controlled by changes in the length of a wood cylinder as it reacts to moisture in the air. It is applicable anywhere that humidifying equipment capable of being operated by electric controls is installed in the air supply system. For use, a knurled ring is turned to set the instrument to the desired degree of humidity, and it will maintain this with a variation of only four percent.

PENCIL SHARPENER IS PART OF DESK SET

A NEW desk set with a pencil sharpener built into it is a convenience in home or office. Held in one hand, the pencil is given a twist or two to the right and receives a new point. Shavings drop into a hollow receptacle. Beneath the sharpener is a compartment for stamps.

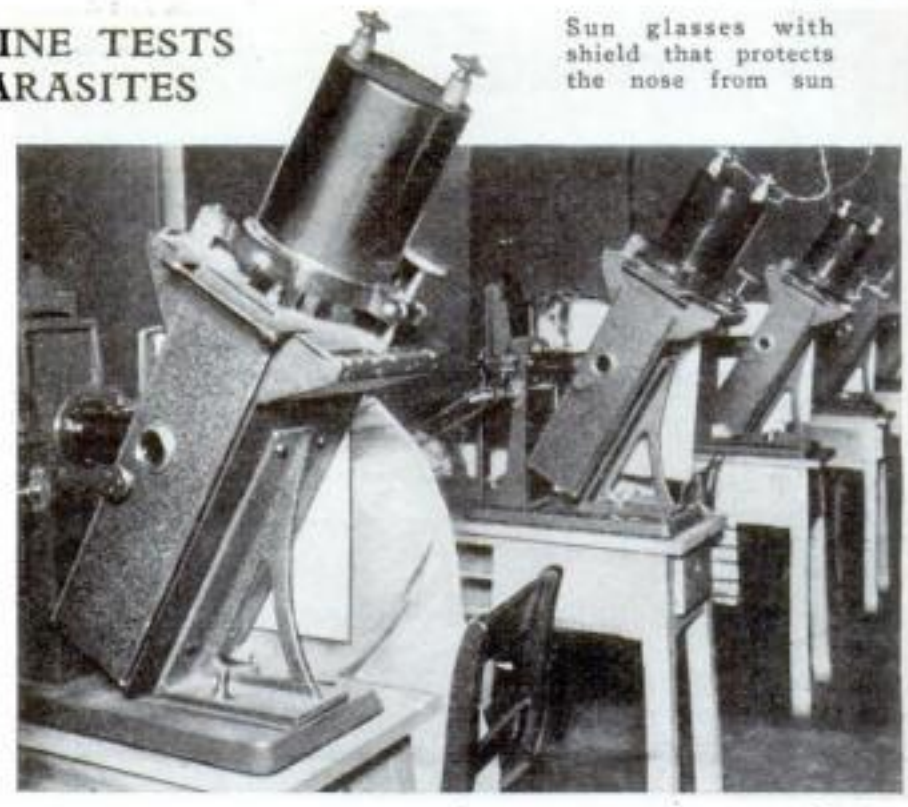
SHIELD ON EYEGLASSES PROTECTS THE NOSE

EQUIPPED with a shield that completely covers the nose, these new sun glasses may not impress the beholder as an aid to beauty, but that is what they actually are. The shield protects the wearer's nose from sunburn and consequent redness. A Los Angeles inventor designed it.

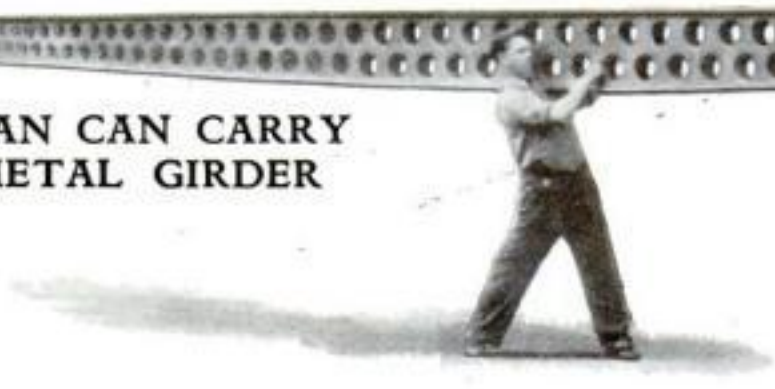
Sun glasses with shield that protects the nose from sun

GERMAN MACHINE TESTS MEAT FOR PARASITES

A BATTERY of curious electric machines helps safeguard the meat supply of Berlin, Germany. These devices, known as opaque projectors, magnify enormously anything placed beneath them. When samples of meat are set under the powerful lamps, a tremendously enlarged picture is thrown on a screen so that the operator can detect any parasites that would make the meat unfit for humans to eat.



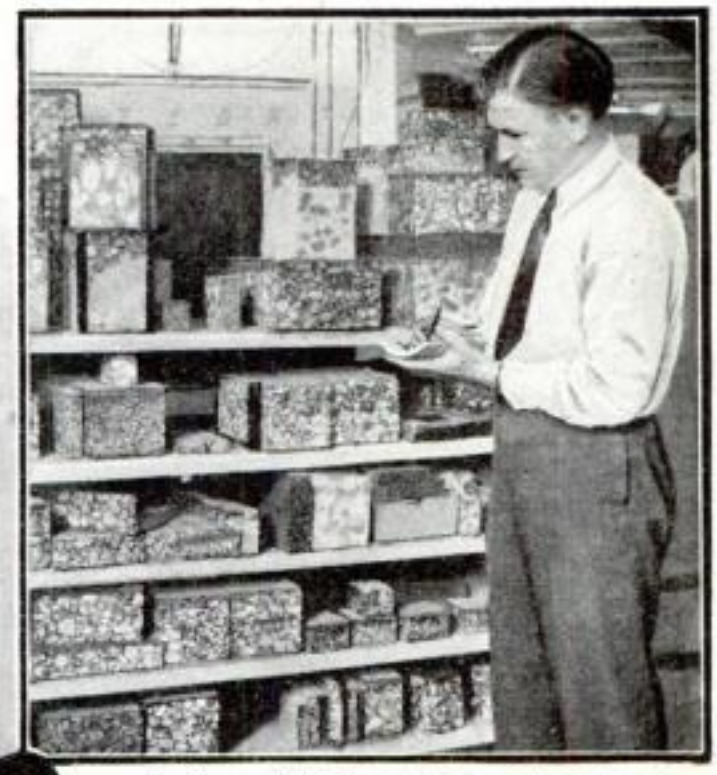
ONE MAN CAN CARRY BIG METAL GIRDER



FOUR men would be needed to lift the girder in this picture if it were made of steel, yet one man carries it with ease because a new alloy of magnesium and aluminum metals used in its construction is even lighter than aluminum alone. It was developed by a Michigan firm to meet the demand for lightness in airships and other structural projects where weight is at a premium. The alloy may be welded, forged, rolled, and cast by ordinary methods.

Boston Hospital for Highways Doctors Sick Roads

Samples of road surfaces arrive in cigar boxes. At right, testing elasticity of asphalt



Sections of highways from all parts of the country are in this testing laboratory

WITH the same painstaking care that doctors and surgeons use in diagnosing a patient's ailments, experts in a unique Boston laboratory examine samples of roads. Cigar boxes filled with paving materials from all parts of the country, as shown in oval above, arrive daily at this hospital for highways. Here they are examined to determine the cause of a road's failure, or the degree to which a new type of highway will satisfy its builder's expectations. The samples are punched by needles, baked in ovens, drilled, and shaken to powder in order to measure all the factors that go into a good road. In one test asphalt is stretched to the thinness of a human hair to see whether it is elastic enough to withstand destruction by severe heat, snow, and ice.

Entirely new types of paving have been developed as a result of research in this laboratory. Some of them are especially planned to be proof against skidding, while others are designed to provide a cheap but good road for farmers. The surface for Cuba's new 700-mile super-highway, called the finest of its kind in the world, was developed here.

PHONOGRAPH RECORD IS MADE ON PAPER

PHONOGRAPH records on paper, costing a cent or two apiece and playing twice as long as standard records, are promised by an entirely new process developed by two young Argentinian engineers. In principle the scheme resembles the method used for sound motion pictures. Apparatus in the recording studio transforms a singer's voice into a flickering beam of light, leaving a sound track of black and white lines upon a sheet of photographic paper moving beneath it upon a revolving drum. The reproducer employs a photo-electric cell to translate the lines back into sound. The paper record is shown above.

TALKIE, PHONOGRAPH, RADIO, ALL IN ONE

A NEW "home talkie" device houses in one cabinet a projector for standard sixteen-millimeter film, a phonograph for the sound accompaniment or for ordinary records, and a radio receiver. Words or music accompanying the pictures are played by sixteen-inch disks, synchronized with the film. The hinged top of the cabinet contains the projecting screen.

This cabinet houses a home talkie projector, a phonograph for sound, and a radio receiver

VIOLINIST ACCOMPANIES HIMSELF ON PIANO

MUSICIANS who play the cornet or violin may accompany themselves on the piano by using an invention of George Cook, Ogden, Utah. Cook has patented a piano-playing device which he pedals with his feet. As he works the pedals, arms come down and strike the keys of the piano. The photograph above shows Cook playing the "um-pahs" with his pedal attachment while he carries the air on his fiddle.

New Wing Flap Helps Plane Land at Low Flying Speed

A WING flap designed to enable planes to handle heavier loads and effect landings in restricted areas recently has been successfully tested by Howard M. Rinehart, veteran aviator and president of a Dayton, Ohio, flying field. The flap is a double thickness of corrugated iron, extending the length of the wing on the under side and controlled from the cockpit. In landing, a ship's speed approximating sixty-five miles an hour has been quickly cut to twenty-five with the flap.

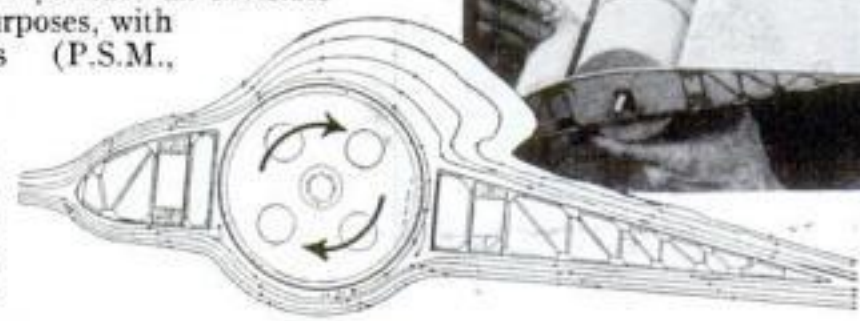
Transparent fabric over steel mesh on new amphibian, above and right, aids inspection

USE TRANSPARENT FABRIC ON NEW AMPHIBIAN

WINGS, rudder, and elevator of the first stainless steel amphibian plane are made of sheer fabric covered with a fine wire mesh of the non-corrosive metal. In consequence, they are transparent, and the fabric and bracing may be inspected from the outside at any time. Besides this advantage, the unusual covering is given added interest by efforts that have been made in England to produce an invisible airplane for war purposes, with transparent wings (P.S.M., Nov. '28, p. 72).

ROTOR ON WING ADDS TO PLANE'S POWER

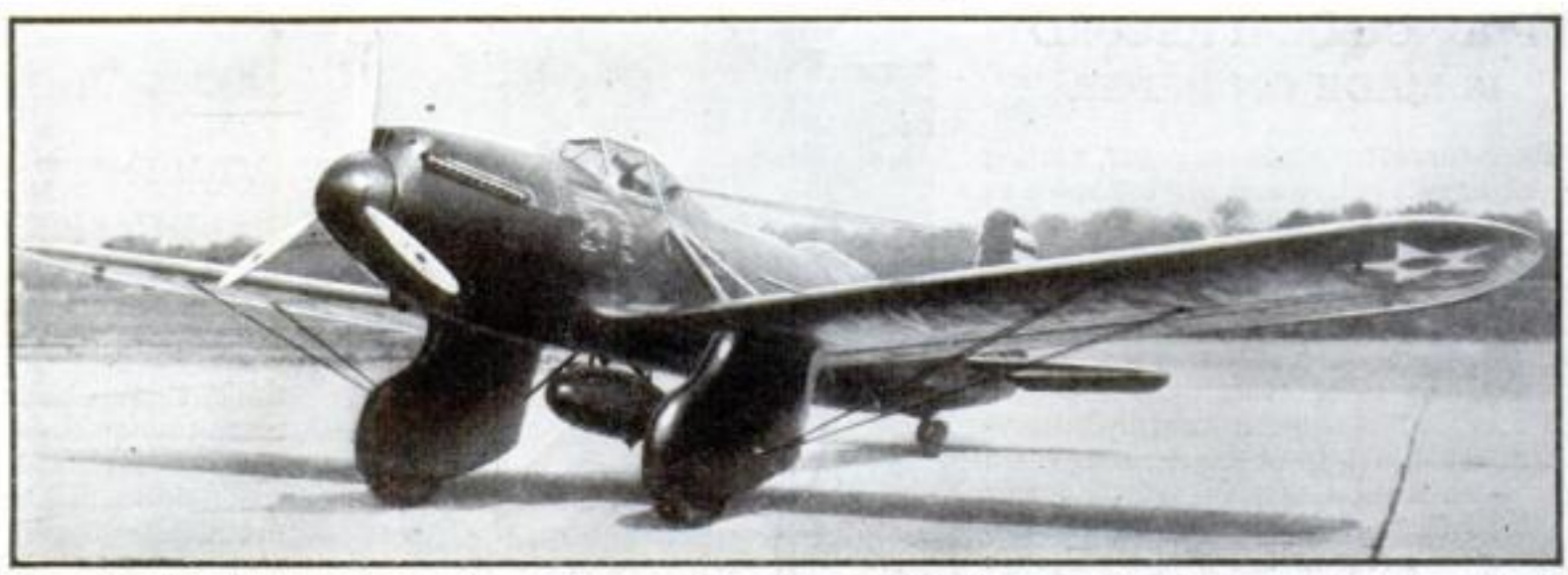
A NEW application of the rotor principle to airplanes is proposed by Ray Thompson, Hollywood, Calif., inventor. By placing a rotating spool at the center of a model airplane wing of otherwise conventional design, Thompson declares the lifting power has been greatly augmented. The effect of the rotor is to increase the partial vacuum above the wing and the pressure of air below it.



A revolving spool set in plane's wing, as seen in model at right, increases its lifting power. Diagram shows how it works

ARMY PLANE DEADLY AGAINST FOOT TROOPS

SO DEADLY is the Army's latest attack plane that experts estimate a squadron of these machines could duplicate the gun fire of a full infantry division. The new craft speeds at nearly 200 miles an hour, and is considered one of the most effective planes ever devised for use against ground troops. The 650-horsepower engine is cooled by a recently-developed liquid more effective than water. For armament the plane carries a bomb and six machine guns.



One of the Army's latest attack planes, which are said to be so deadly that a squadron of them could do the work of an infantry division. Each plane carries six powerful machine guns—four in the wings—and a bomb between wheels

GERMAN TAIL-FIRST PLANE FLIES ACROSS CHANNEL

GERMANY'S tail-first plane, which appears to be flying backward, soared across the Channel to visit Britain in one of its first trial flights of any length. The triangular control surface at the upper right of the photograph above is the forward end of the strange-appearing craft when it is in flight.

TEST BIRDLIKE PLANE

TO TEST the possibility of patterning an airplane after large soaring birds, a California inventor has constructed the model seen above. It will be tried out in a wind tunnel to see if it possesses the lifting power and stability of more conventional designs. The inventor hopes his machine will emulate birds that with little apparent effort sail into the wind.

LIFE RAFT ON WING TO AID SEA FLYER

A SAFETY device for Army land planes that fly over water has been invented by Lieut. George P. Tourtellot, Army Air Corps pilot at Wheeler Field, Hawaii. It consists of a life raft carried in a streamlined metal container on top of the wing. In the event of a forced landing on water, the pilot would have time to open the container, inflate the rubber raft, and float on it until rescued. Because of its tapered shape, the container creates only slight drag upon the airplane in flight.

Above, the life raft container on seaplane's wing. At right, the container open, showing boat

Above, airship dock at Akron, Ohio, where the *Akron* was built and where its sister ship, *ZRS-5*, is now in course of construction. In circle, workmen assembling the main rings—the bones of the ship

SECOND AIR GIANT NOW BEING BUILT

FOLLOWING the U. S. Navy's acceptance of the super-airship *Akron*, construction of its sister ship, the *ZRS-5*, has begun in the giant dock at Akron, Ohio. The accompanying photographs show workmen assembling the main rings that will be the bones of the dirigible's envelope. Like the *Akron*, this craft is destined to become a naval warship of the air. Possession of the two air leviathans will maintain the world supremacy of the United States' lighter-than-air fleet. The next step is expected to be airships of equal size for commercial use.

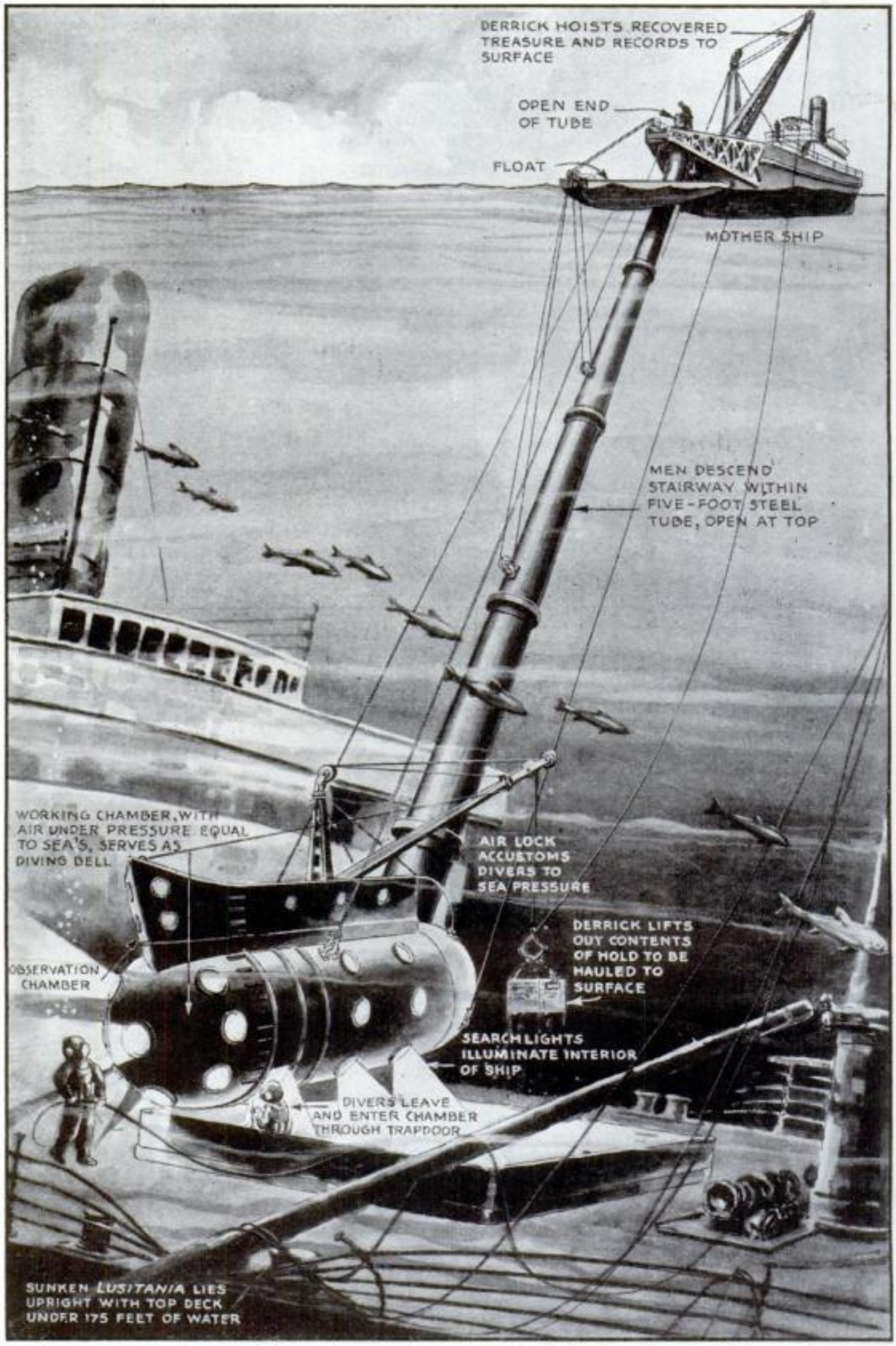
Stairway *to* Ocean Bed *may recover*

Odd Device for Salvage of Lost Liner

EARLY this year, if all goes well, a vessel will steam to a point eight miles off Old Kinsale, on the Irish Coast, and drop anchor near a buoy that marks the spot where sounding has shown the sunken liner *Lusitania* lies. Then the vessel will lower one of the strangest of all diving contrivances—a stairway to the bottom of the sea, inclosed in a five-foot tube of steel, down which men can walk almost within touching distance of the lost ship's hull. Finally divers will emerge from a bulbous knob at the tube's end, and set about salvaging whatever valuables they can find.

There may be treasure to be found; some rumors, not universally credited, place between four and fifteen million dollars' worth of specie and jewels aboard the liner. Documents of historical and sentimental interest are a principal object of the quest. Above all, however, the attempt may vindicate a twenty-year-old dream of Simon Lake, American inventor, often called "the father of the submarine," by demonstrating that his submarine tube is a practical means to recover the contents of lost ships.

The main part of this device is simply a staircase, inclosed below water level in a steel well or tube. Its open upper end is swiveled to a mother ship; its lower end terminates in an observation chamber. Here men may sit, under normal atmospheric pressure and observe through portholes the placing of the tube upon a treasure ship. For this operation, air tanks buoying up the tube are emptied, and its own weight holds it fast to the deck of a derelict. Divers may then leave the chamber through an air lock and diving bell arrangement. Instead of having to make a tedious ascent to the surface after a shift, they may return to the submarine chamber at any time to rest. Undisturbed by surface storms, they may work in all kinds of weather practically without interruption.

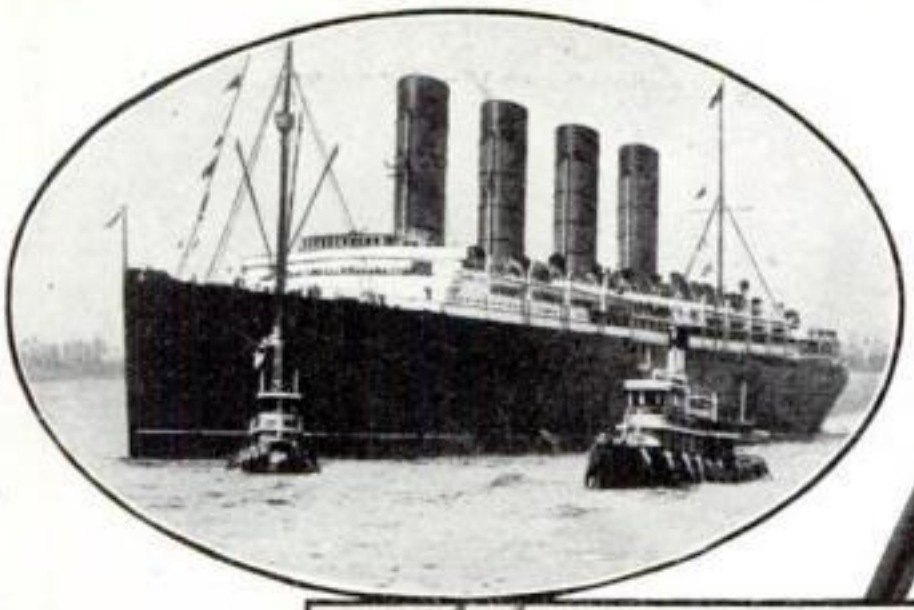


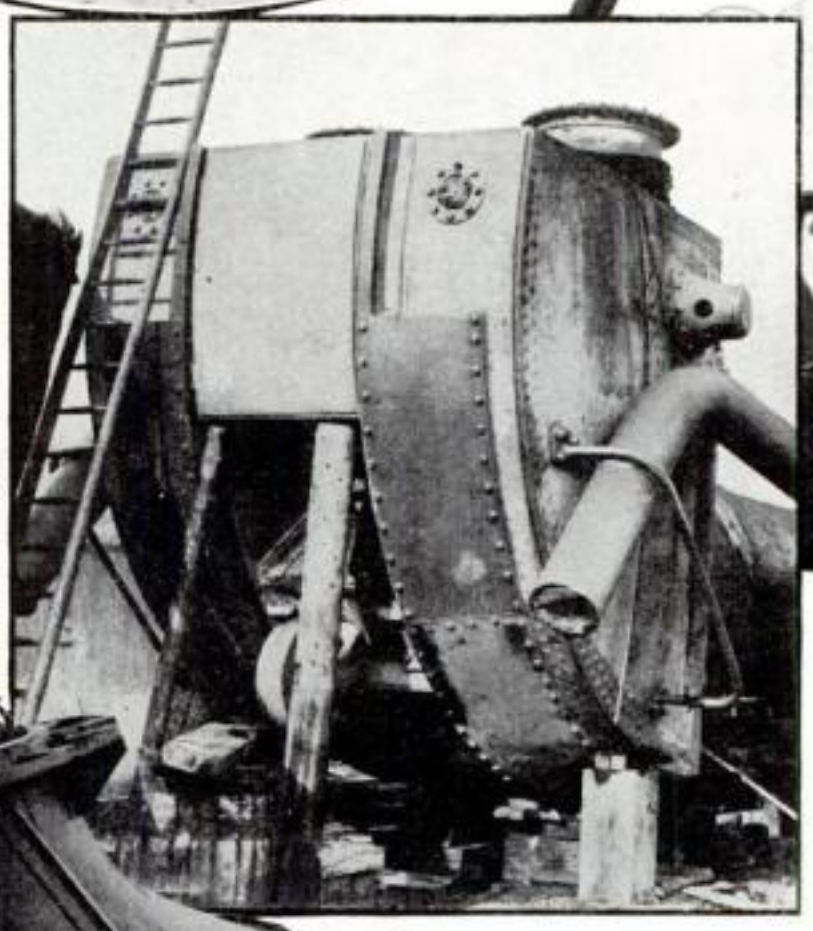
How Simon Lake's tube may salvage *Lusitania's* gold, shown above in sketch based on his original design

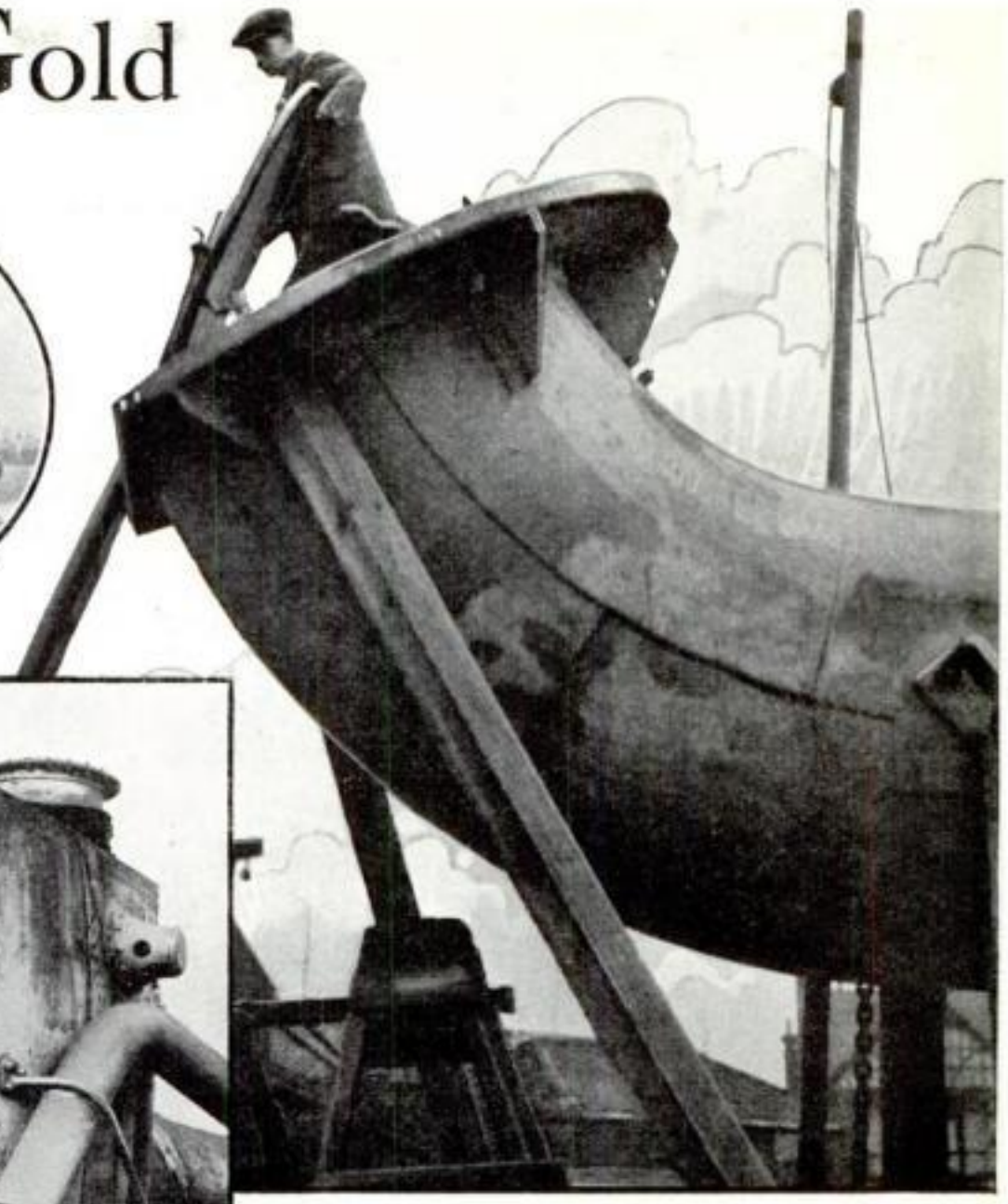
Lake built such a tube with the intention of recovering $6,000,000 from a sunken British frigate near the Zuyder Zee, Holland. The World War halted this project, but provided another when the *Lusitania* was sunk. Following several other unsuccessful attempts to reach the liner in the comparatively deep water where it lies, Lake recently obtained backing to try his tube scheme.

The old submarine tube was taken to Brightlingsea, England, and lengthened. At this writing there remained only the final tests of the tube, and the technicality of obtaining official British approval of the plans, before the start under the leadership of Capt. H. H. Railey. Lake will accompany the expedition as technical operations chief. The expedition plans to make submarine photographs

Lusitania's Gold







Above, the *Lusitania*, once a proud giant of the sea, now lies on the bottom of ocean off the Irish coast. A new attempt is to be made to salvage her treasure. At right, lower end of tube, showing modified diving chamber and trapdoor. Below, a general view of the submarine tube to be used in reaching the *Lusitania*

Thrilling New Feat of Ocean Salvage Is Made Possible by Huge Tube

At top, upper end of the big salvage tube showing how the men will enter it from the ship at surface. A stairway leads to the diving chamber at the lower end

with a special camera adapted for use under water.

For years Simon Lake has dreamed of the venture that seems about to come true. As long ago as 1918 he wrote, in his book, *The Submarine in War and Peace*, after testing a crude type of submarine tube:

"Diving as heretofore conducted has been difficult and dangerous work, and only the strong could stand the hardships connected with it. The semi-submergible boat has met the problem squarely. This consists of a tube of any desired length that may be increased by the insertion of additional sections. It is provided with an operation compartment or working chamber at its free end, with a hatch and door in its bottom so that divers can be sent out. The tube may have its upper end attached to the side of a surface craft, but preferably floats in the well of a craft specially designed to work in combination with it. It will be seen that the operators are protected from the currents, and even quite a severe storm on the surface would not interfere with work below, so long as the surface vessel could be held to its moorings.

"In many waters the divers would be engaged in plain view of the tenders in their operating compartment, who would handle the lines and transmit signals by bell or telephone to the control station on the boat above. Work is thus carried on continuously by relays of divers. Through the medium of the equalizing room or air-lock, the divers, who leave their helmets, shoes and weights in the operating chamber, are able to undergo slowly and comfortably decompression or compression. This compartment is well lighted, is fitted with seats, and provides every reasonable convenience.

"The ship's hold is lighted electrically, and the work of removing material follows. A light down-haul line is led through a block secured conveniently to the diver's station, and is handled by an electric winch in the operating compartment. Its purpose is to return the hoisting line with its sling to the divers after each load has been discharged upon the surface craft."

That is the system that is about to meet its most crucial test. Should it succeed, the way will be opened for attempts to recover valuables from lost vessels.

· FROGS *by the* Million

READY FOR CITY MARKET

At right, bullfrog at earliest marketable age. It is one year old and about twenty inches long and when dressed weighs one pound. Formerly only hind legs were eaten, but now forelegs and back are sold

A panful of frog eggs. Gathered like this, and not in dip nets, they are transferred to the tadpole pool where they hatch in safety

By
H. H. DUNN

A SCRAP of red flannel, a bent pin, a piece of string, and a willow pole in the hands of a small boy on the bank of a Michigan creek twenty-five years ago have led to the development, in southern California, of one of the most unusual stock ranches in the United States. On this farm the productive acres are covered with water, and the cattle are a million bullfrogs in all stages from tiny tadpoles to four-pounders whose bellowing on moonlight nights might be mistaken for those of young bulls.

The boy in Michigan caught wild frogs for his family and friends. He had to walk about a mile to the creek. One day, he brought home a dozen extra bullfrogs, put them in an artificial pond, and in a year was raising so many frog-legs he no longer had to take the two-mile walk. He admits this is the first time that boyish aversion to work led to a new industry. He studied frogs, frogs' legs, and frog raising, but his parents' opposition kept him, until recently, from going into frog farming as a life work.

A short time ago, M. W. Herriman, the one-time Michigan boy, came into possession of a ranch, near San Diego, through which runs a shallow valley, headed by a well that produces as much water in summer as in winter. He laid off six acres of the lower end of this valley into ponds—one for grown frogs, another for tadpoles, a third for surface minnows, and a fourth for crayfish. These ponds average 200 by 300 feet in size and are about two feet deep with water, in which arrow weed, wild rice, cat-tails, and other marsh plants

Three-month-old bullfrog tadpoles, about two inches long. Before changing to frogs they will reach a length of about six inches

are encouraged to grow. Castor beans were planted in the dikes around the ponds, to give quick shade.

Around the larger pond, he built a heavy board fence four feet high, set one foot in the ground, to keep out cats, raccoons, skunks, and snakes. Electric lights were strung across this pond, and racks were built at intervals through the center, over which leaves or burlap could be thrown to supply shade.

THERE are no bullfrogs native to the Pacific coast, so from the bayous and marshes of Louisiana Herriman imported fifty-three pairs, for the bullfrog is monogamous. They cost him $10 a pair. Into the crayfish pond went 1,000 crayfish from Louisiana and Oregon, some of the latter being six or seven inches long and resembling small lobsters. From Louisiana came 8,000 surface minnows, tiny fish reaching a maximum length of one inch. They went into the minnow pool.

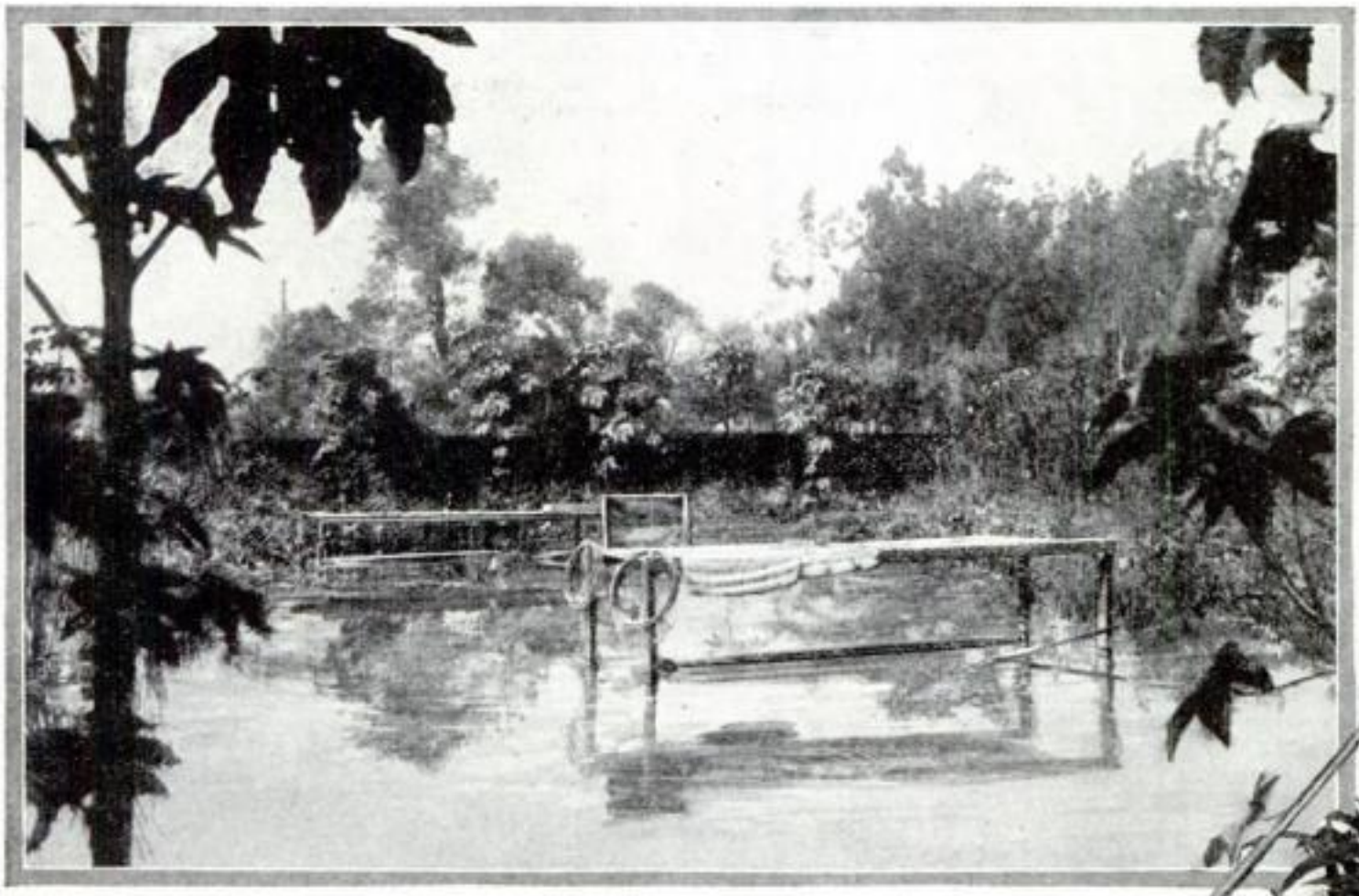
"Bullfrogs have only one mate, but they are cannibals with voracious appetites," Herriman told me. "They will eat their own tadpoles just as rapidly as the latter are hatched. Therefore, I have to

One thousand pairs of crayfish like this one were imported. The frogs eat their offspring

keep the second largest pond, quite apart from the fenced-in breeding pool, solely for the tadpoles. Last August, each one of the female frogs laid approximately 20,000 eggs, in strings, agglutinated into mats, on the surface of the water, around the stalks of the cat-tails and other aquatic plants.

"With a shallow tin pan, I dipped these eggs, two or three pounds at a time, out of the breeding pond. I found that a dip net could not be used because the masses of eggs, each about the size of a No. 4 shot pellet, broke through the meshes and were lost. Then I gently poured the eggs from the pans into the tadpole pond. Bullfrogs lay their eggs at night, among the stalks of the vegetation at the edges of the pool, so that I was out at daybreak, throughout the spawning season,

Raised *on* Odd Farm ·



This pond is the home of the bullfrogs. Here they grow to marketable size protected from their enemies by a wooden fence about four feet high

ACTIVE FROG ESCAPES NET

M. W. Herriman, farmer of a million frogs, is an expert with the dip net that is used to capture the big ones. Now and then one escapes, as photograph shows

• Strange Story of Boy's Laziness That Resulted in Business Venture on California Ranch That Gives the Farmer Huge Profits on His Small Investment

collecting and transferring the eggs."

During his boyhood, Herriman had found that the eggs hatched more rapidly and the tadpoles developed faster in slightly warm water. He could not heat the tadpole pond without considerable additional expense, so he made it shallow, eight to ten inches deep. He fills it with water some weeks ahead of the time for transferring the eggs, so that the temperature will be higher than that of the other ponds.

THE eggs hatch in about three days, averaging about seventy-five percent tadpoles, though Herriman is endeavoring to devise better methods of transferring the eggs, as well as of caring for the breeding stock, so that each female will deposit about 30,000 eggs, nearly ninety percent of which will hatch. When born, the tadpoles have little oval, dark-brown or black bodies slightly more than one quarter of an inch long, with tails another quarter of an inch in length.

For two or three weeks groups of them cling tightly to submerged rocks, roots, and stalks of aquatic plants, apparently living on egg material still contained in their bodies and the slime on the stalks of the plants. At the end of three weeks, they have grown to one and one half inches in length, and swim freely, packing the pond until some corners of it look like a solid brown mass.

"Provided as they are with gills, these baby frogs live like fish in the water," continued the frog farmer. "In the wild state they seem to form one of the principal sources of food for the adult male frogs. Tadpoles are supposed to live only on vegetation, but my observation has been that they are scavengers. They have two rows of teeth on the upper jaw, and three on the lower, which they lose when they drop their tails, abandon gills, develop legs, and become frogs—real amphibians. With these teeth, even at a very young age, they tear almost microscopic pieces from water-soaked meat, and are as perpetually hungry as a litter of young puppies.

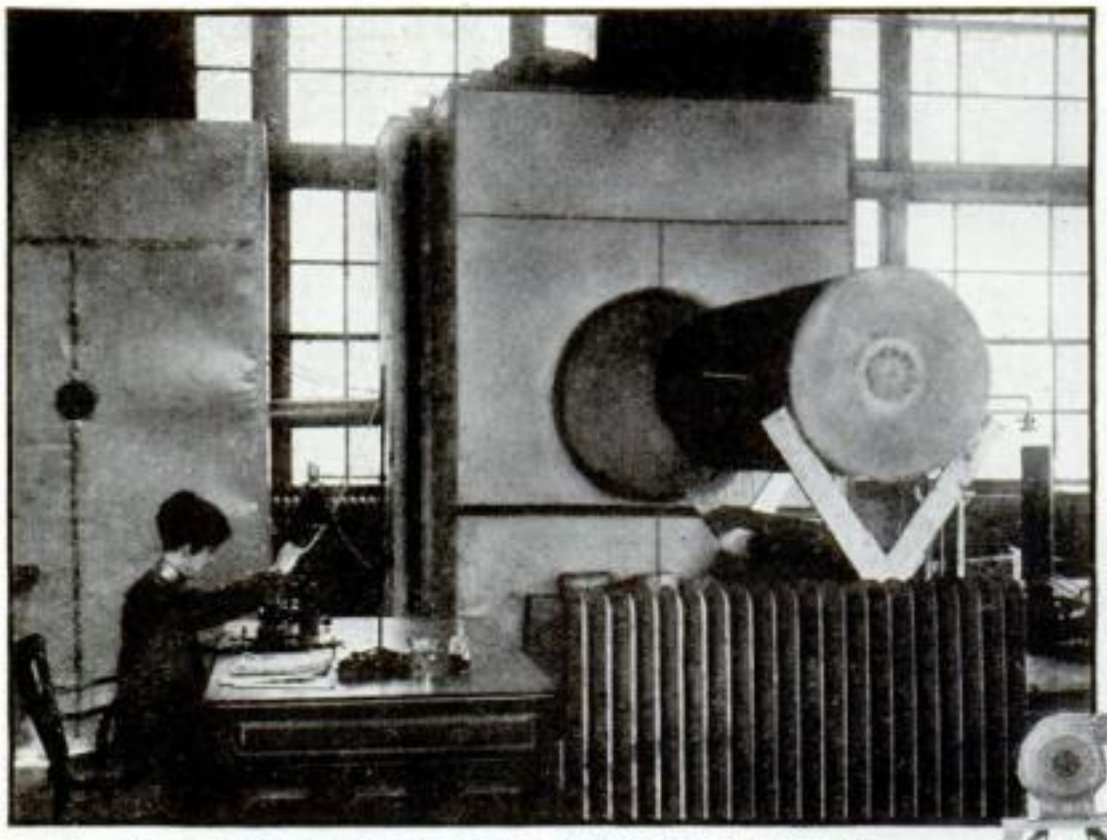
"One of the objectives in rearing frogs, as with cattle or pigs, is to bring them all to a uniform, marketable size at the same time. This is best accomplished by systematic feeding. Dry oatmeal and liver, finely ground together and scattered in the pond, has proved by experience to be the best food for them. As they grow larger—for this variety attains a length of six or seven inches before final transformation into the frog—the tadpoles will eat chopped worms, rough meats, fish, and even table scraps. When they are small, however, uniform feeding gets the best results."

THE sound of our footsteps along the dike surrounding the tadpole pond brought what seemed to be the entire million or more of the little brown, tailed pollywogs to the surface at the edge of the pool. They were then, in November, more than two inches long, and their consistent sameness of size testified to the efficacy of Herriman's feeding method.

Their worst enemies, at this stage, are their parents. After that, as they are transformed into small frogs, several varieties of snakes, wild ducks, wading birds of all kinds, and wild animals as well as domestic cats prey on them. While they are tadpoles, however, they have few enemies; and, being protected from the adult frogs, about ninety-seven percent of them become frogs.

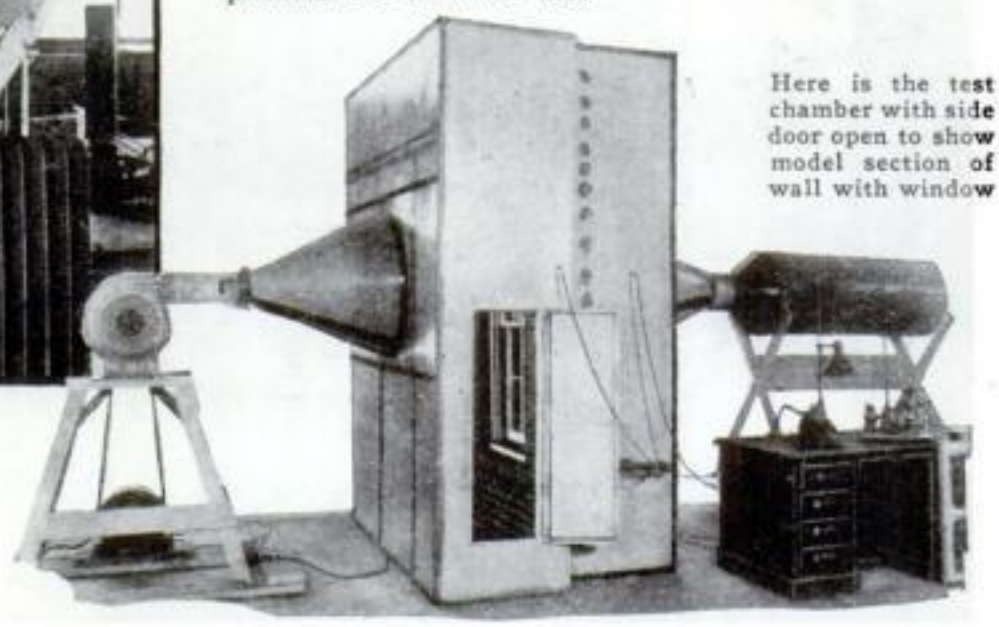
When the tadpoles are one year old, their troubles, and those of the frog farmer begin. Through the winter, bullfrog tadpoles sink to the bottom of the pond and hibernate, *(Continued on page 134)*

Use Huge Blowers in Measuring Air Leakage Through Walls



This huge blower is being used to force air through a model wall inclosed in an air-tight chamber. The experiment is made to measure leakage of air through building walls

To OBTAIN more exact knowledge of the rate at which air leaks through the walls of buildings and houses, a model section of a wall and window are undergoing tests by engineers of the American Society of Heating and Ventilating Engineers and the U. S. Bureau of Mines, at Pittsburgh, Pa. Huge blowers are used in attempts to force air through the wall, while instruments record the results. Air leakage has hitherto been one of the few uncertain factors in designing a heating and ventilating plant. It is particularly important in connection with modern gas and electric heating plants, and air-cooling apparatus for summer use.



Here is the test chamber with side door open to show model section of wall with window

DISCOVERY OF GIGANTIC PLANET IS PREDICTED

DISCOVERY of a new planet, five times as large in diameter as the earth and even more remote in the solar system than Pluto, last-discovered planet, is predicted by Prof. William H. Pickering, renowned American astronomer. Eccentricities in the behavior of the planet Uranus, observed by Pickering at his private observatory in Mandeville, Jamaica, led him to this conclusion. Pickering was one of the two astronomers who predicted the discovery of Pluto early in 1930.

YAP'S STRANGE COIN WEIGHS 120 POUNDS

AS HEAVY as some full grown men is a strange coin used as money on the island of Yap, in the South Pacific, for it weighs 120 pounds. With one of these, a visitor to the island could buy a good eighteen-foot canoe, a quarter-acre of land, or about 10,000 coconuts. Natives carry the huge coins by inserting a pole through the convenient hole drilled at the center. The specimen in the photograph was recently brought to America, where it will be added to a New York bank's collection of more than 40,000 varieties of money.

AMERICAN UNDERGROUND HOME REBUILT

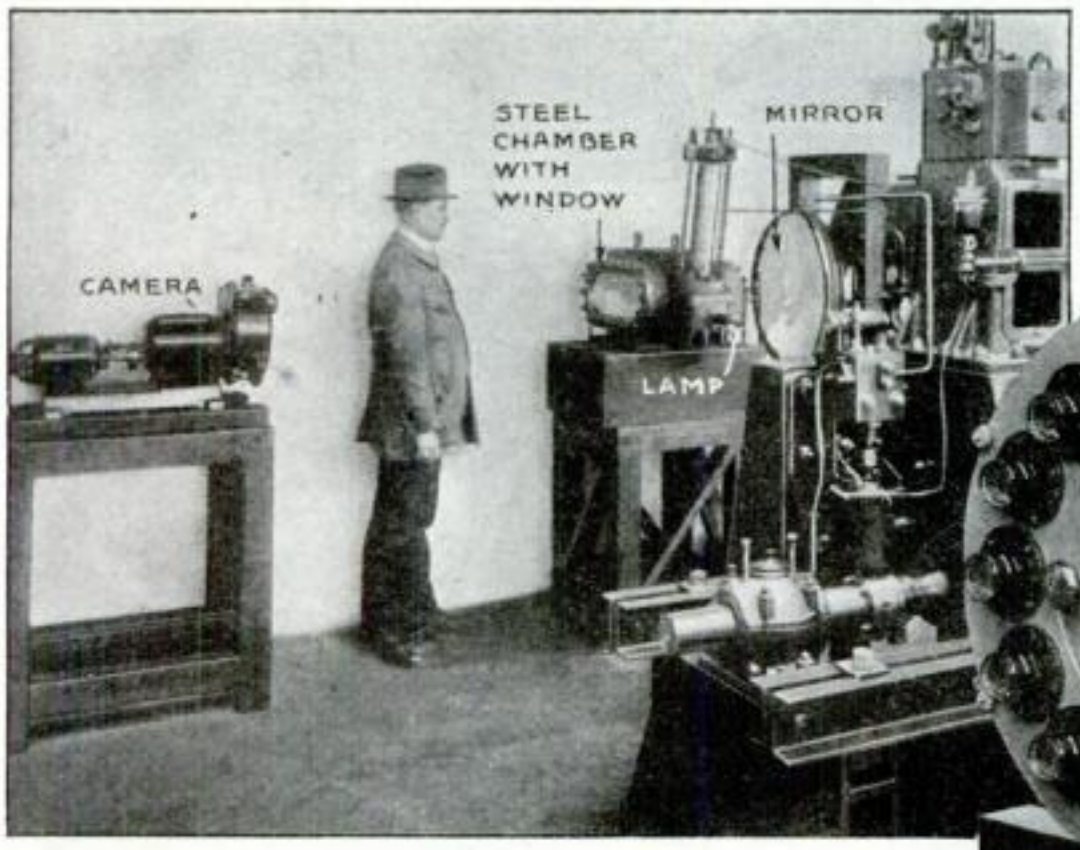
Below, a reconstruction of the subterranean house found in Arizona. Note ladder leading to door

At right, rebuilding underground home of primitive Americans

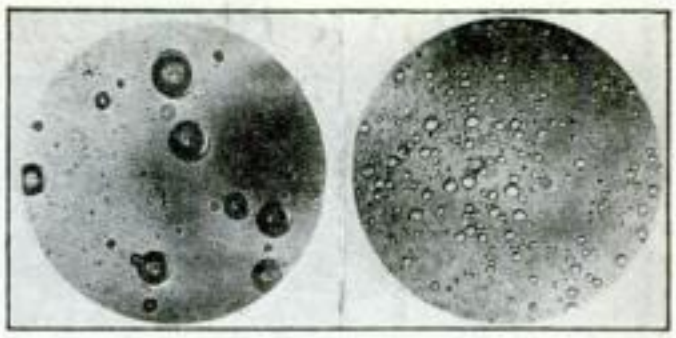
WHEN archeologists, excavating near Allentown, Ariz., came upon ruins of the strange underground dwellings of primitive Americans, they decided to reconstruct one of the houses exactly as it once existed. Careful measurements enabled the dwelling to be rebuilt much as it must have appeared 2,000 years or more ago when it first was built.

Roofed over nearly flush with the ground as a possible protection against wild animals and hostile tribes, these houses were entered through a front door in the roof. A ladder led to the roughly excavated interior, which was provided with a ventilating shaft and with dividing walls subdividing a number of households in their respective apartment—the earliest-known ancestor of this modern housing system. Houses similar in construction were occupied by the mysterious Basket Weavers, whose homes have been dated by rings in wood found in them.

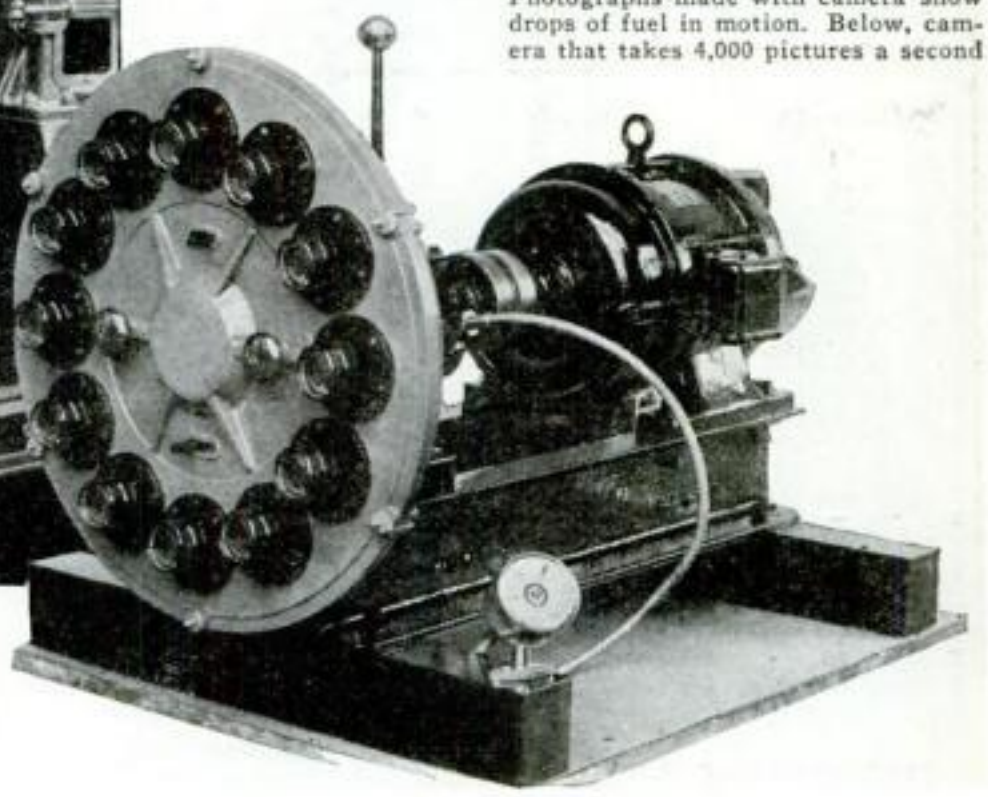
NEW CAMERA FINDS AUTO FUEL SECRETS



When gas is injected into a steel chamber with glass window, photos are taken with high-speed camera

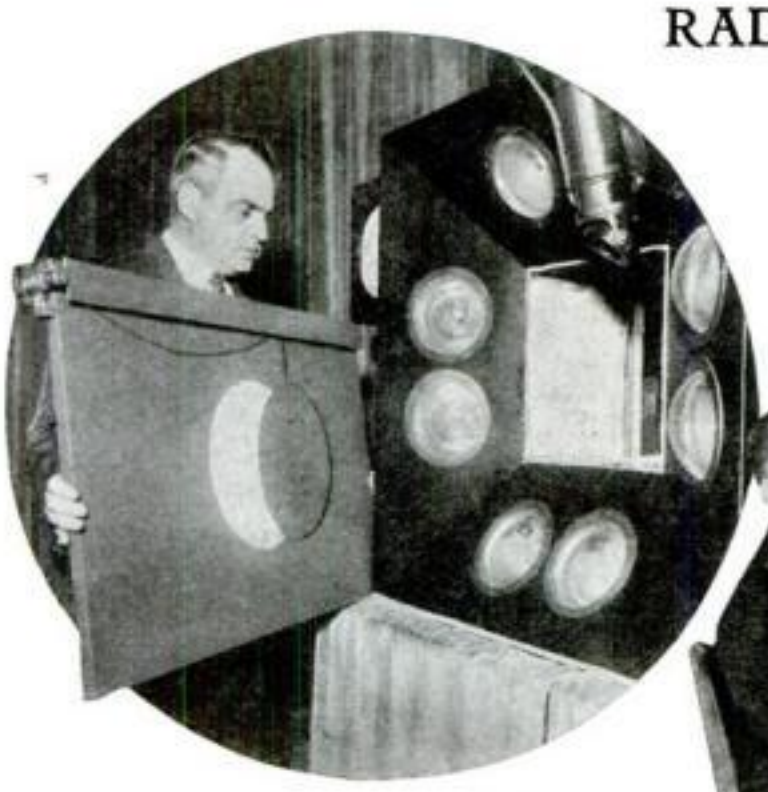


Photographs made with camera show drops of fuel in motion. Below, camera that takes 4,000 pictures a second



EQUIPPED with twelve lenses, and capable of taking 4,000 pictures a second, a new type of high-speed camera has been developed in Germany. It is being used to learn just what happens to gasoline from the time it leaves a motor's carburetor until it is ignited. Experiments made by spraying fuel into a glass-inclosed chamber show for the first time the exact relation of pressure in the cylinder, and other conditions, to complete pulverization of the fuel. This is essential for perfect combustion, which results in greatest efficiency and avoids the discharge of poisonous carbon monoxide gas into the air. In the top photograph, large globules at left would burn poorly; pulverized ones at right would burn well.

RADIO LIGHTS WIRELESS MYSTERY LAMP



TELEVISION MAY SHOW NEXT ECLIPSE OF SUN

WHEN the total eclipse of the sun, which is to take place next August, becomes visible to sightseers in a narrow strip of Canada, Vermont, and Massachusetts, other thousands of Americans may also view it by television. This possibility, suggested by Dr. Elihu Thomson, of the General Electric Company, was recently tested in a remarkable experiment. A machine was devised to provide an artificial eclipse, consisting of the gradual obscuration of a white-painted circle representing the sun by a circular disk. The synthetic eclipse was then televised.

A MYSTERY lamp, recently exhibited by Westinghouse engineers, lighted brilliantly, though its five-foot wiring had no visible connection with electrical apparatus. The secret was a high-power radio tube that shot from a near-by aerial, transmitting enough radio power to light all lamp bulbs within forty feet.

BELLOWS AIDS HORN PLAYER

TO AID players of such horns as the double bass and tuba, who have found long sustained blowing feats impossible by ordinary means, a bellows has been invented. Worked with the foot, it passes air over an electric light and through a water tank, warming and moistening it, and conveys it to the player's mouth.

AUTOMAT RECORDS VOICE AND TAKES PHOTO

AUTOMATS that will take your picture or record your voice at the dropping of a coin have appeared before, but these are now combined in a single new machine. The subject enters a cabinet, picks up a hand microphone, and deposits a coin. A camera blinks at him, and words spoken into the microphone are recorded on a small record. When the record is delivered a head-and-shoulders photograph of the subject appears upon a disk of sensitized paper at the center.

Coin-in-the-slot automat that takes a picture and records voice on the disk that is shown at the right

DIAMONDS NOW MADE BY SECRET PROCESS

ARE synthetic diamonds now a commercial possibility? Hitherto such stones produced artificially have been too small to be of appreciable value, but a Berlin chemist, Dr. George Senfter, is reported to have found a way to manufacture good-sized gems that look like diamonds. In the new method, of which the details are carefully guarded, a secret mixture is fused with coal in a graphite crucible at a temperature of 3,000 degrees. When the resulting mass is processed and broken up, sparkling fragments of artificial diamonds are said to be obtained.

Dr. George Senfter, Berlin chemist, at work with secret mixture that produces diamonds

PLAN BIGGEST SEAPLANE

PLANS for a giant flying boat twice the size of Germany's famous *DO-X* are being completed by the British Air Ministry, it is reported. Capable of carrying 120 passengers, the craft would be powered by motors totaling 60,000 horsepower.

FIREWORKS ROBOT SEIZES FLAMING FOOTBALL

A GAME of Rugby football was played in fireworks recently in England as a spectacular part of a great pyrotechnic display. At the climax, a robot goalkeeper outlined in flames recovered a blazing ball from beneath a pair of flaming goalposts.

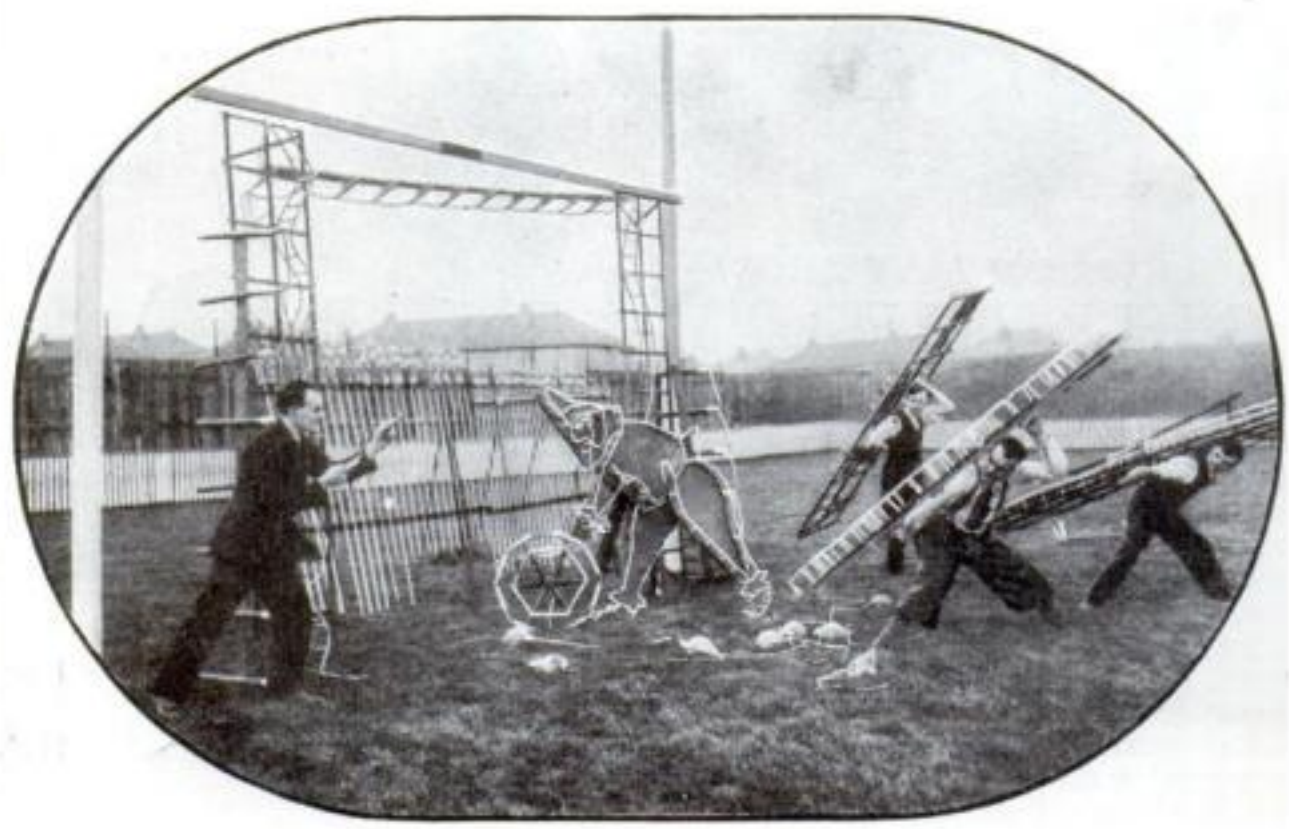
A rehearsal of the thrilling episode is shown in the photograph at the right. The celebration commemorated the anniversary of the discovery of the Guy Fawkes Gunpowder Plot, a conspiracy to blow up the British Houses of Parliament a little over three hundred years ago, which is observed in England much after the fashion of Fourth of July in this country.

BRUSH IN SHAVING KIT FOLDS

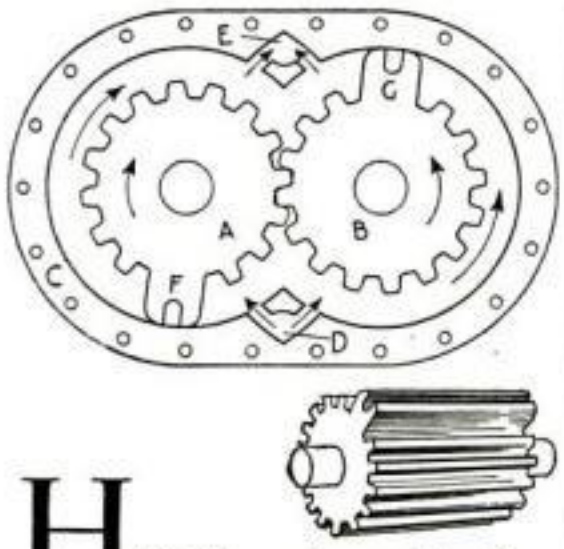
A FOLDING shaving brush, with four hinged sections that join to form a square tuft of bristles, is a recent invention. This innovation has made possible an amazingly compact traveling kit no larger than a cigarette case and containing, according to its maker, everything for a perfect shave. The brush, unfolded, lies flat on the bottom.

SUCTION CUPS HOLD WINDSHIELD WIPER

TO CURE an automobile windshield wiper of the annoying habit of edging into the driver's field of vision when it is not supposed to be in operation, a new vacuum cup anchor has been devised. Attached to the glass by a suction cup, its brass hook tethers the end of the wiper blade so that it cannot jiggle down into the driver's line of vision. The wiper is easily released for operation when needed.



I *Can* You Invent It?



HERE is an incomplete plan for the pressure chamber of a rotary steam engine. It is to consist of the two geared rolls or pistons *A* and *B* (of the type shown in the small perspective drawing at the right), surrounded by the shell *C*. The steam enters at *D* and exits at *E*. The pistons must revolve in the directions shown by the arrows. The power can be transmitted from the shaft of either *A* or *B*.

How would you redesign and readjust the roll-pistons so that the motor will run as indicated, *and utilize the steam pressure to the best advantage?* The ends of any long teeth (such as *F* and *G*) must travel in pressure-tight contact with the inner surface of the shell *C*.

* * *

Here is the solution of the right-angled power transmission problem given last month. The bell crank *C* of the original mechanism is replaced by the gambril crank *C*, pivoted at both ends to the yoke *G*, rotating on its center bearing *D*. Bearing *D* is placed out of line with the intersecting axes of the shafts *A* and *B*. At every point occupied by the journal joint *E* during the rotation of the shaft *A*, a twisting motion is given to the yoke *G* on the center bearing *D*. At no point can bearings *E*, *D*, and *F* become aligned, and the dead center is therefore avoided.

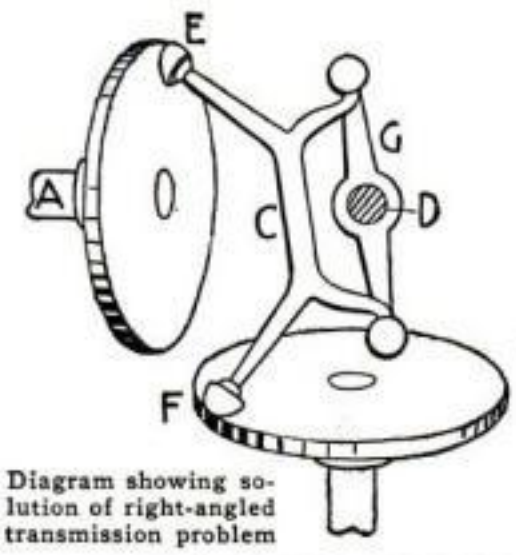


Diagram showing solution of right-angled transmission problem

MACHINE BETTER THAN EYE TO TEST COLOR OF FOOD

EXPERTS of the U. S. Department of Agriculture employ an ingenious machine to check up on the color of ketchup and other foods. With a series of tinted disks prepared for the purpose and mounted on a rotating table, any color standard may be duplicated. Placing this beneath one lens and a sample of the ketchup under the other, an observer can tell at once whether they match. This device relieves the human eye of the sole responsibility of deciding if a sample color is the same as the standard. The tests are made for the purpose of being sure that the Pure Food Law has not been violated by the use of illegal coloring matter.

DOUBLE NOZZLE AIDS FIREMEN

How it is possible to keep cool amidst raging flames was demonstrated by firemen of Wimbledon, England, the other day. A new style of nozzle throws two streams of water. While a concentrated jet is aimed at the fire, a protective blanket of spray is thrown around the firemen, enabling them to approach much closer to a burning structure than was possible with the old-style equipment.

NEW BATTERY TERMINAL HAS A SPLIT POST

PROOF against loosening, according to the inventors, is a new type of storage battery terminal for car and radio owners. This terminal consists of a split post on the battery which may be expanded by a tapered screw. When the entering screw presses the split halves, wedge fashion, against a solid-ring conductor, a firm contact is made. Wear and corrosion are said not to impair the terminal's efficiency.

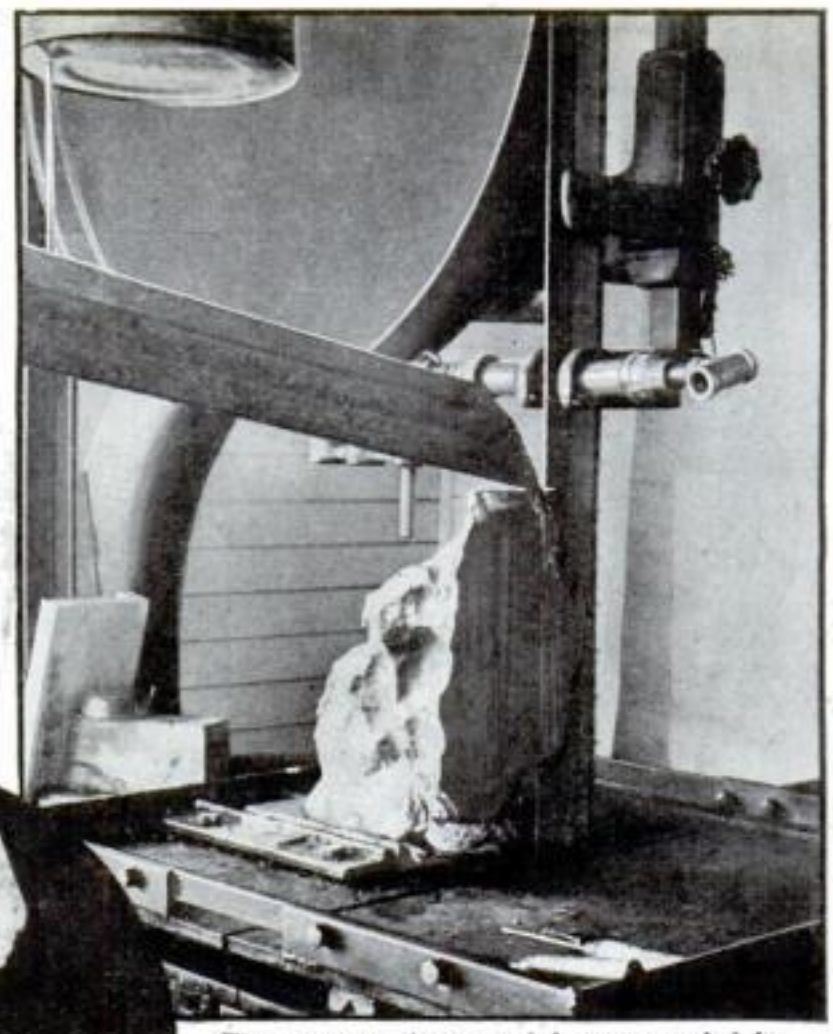
CAR COUPLERS JERKED BY "BRONCHO"

A mechanical "broncho," clamped to the rails, is worked by air cylinders to throw sudden strain on car couplers to test efficiency

How much strain will the couplers between railway cars stand before they will break? To find this out, one Eastern railroad uses a mechanical broncho that is clamped to the rail. Then sudden shocks are applied to the coupler by means of levers worked by large air cylinders. The ability of couplers to withstand these shocks, similar to those the coupler is subjected to in actual service, determines their fitness.

America's Only Meteor-Polishing Shop

At right, the meteor-cutting band saw in operation. Below, H. H. Nininger applying acid to meteor



The patterns shown at left are revealed by the acid and disclose meteor's composition

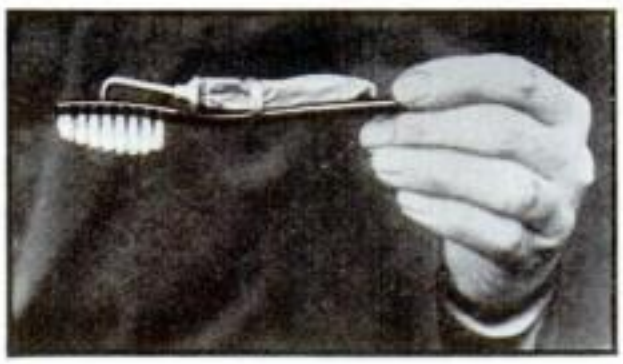
If a meteorite were to fall in your back yard, and you wished to have it properly polished and mounted for study, you would ship it to a little laboratory in the mountain town of Palmer Lake, Colo. Here, in what was once a country store, Prof. H. H. Nininger of the Colorado Museum of Natural History has the only public meteor-cutting plant in the Western Hemisphere. His customers are usually museums and universities.

First the meteorite is mounted in a plaster cast on a moving table, and sliced with a special band saw of soft steel assisted by a constant flow of abrasive from a trough. This is a delicate and lengthy process; one meteorite took 150 hours to cut. Then abrasive wheels polish the cut surface to mirrorlike gloss. Finally the surface is etched with nitric acid to bring out the markings that reveal the meteor's composition and past history. A touch of lacquer preserves the finished surface from oxidation.

In the little more than a year since the plant was opened, Nininger has classified some seventy distinct types of meteorites, which fall into three main groups in order of frequency: stone, iron, and a mixture of the two. His studies reveal that most meteors are traveling about thirty miles a second when they hit the earth's atmosphere.

WINDOW IN PAPER BAG TO CHECK CONTENTS

So that a purchaser may see what he is getting, a new type of paper bag for groceries is provided with a window of transparent material. It is therefore unnecessary to open the bag to examine the contents. Storekeepers may also check up easily on their wares in this manner, while at the same time keeping them in a fresh and salable condition.



PASTE NOW ATTACHED TO TOOTHBRUSH

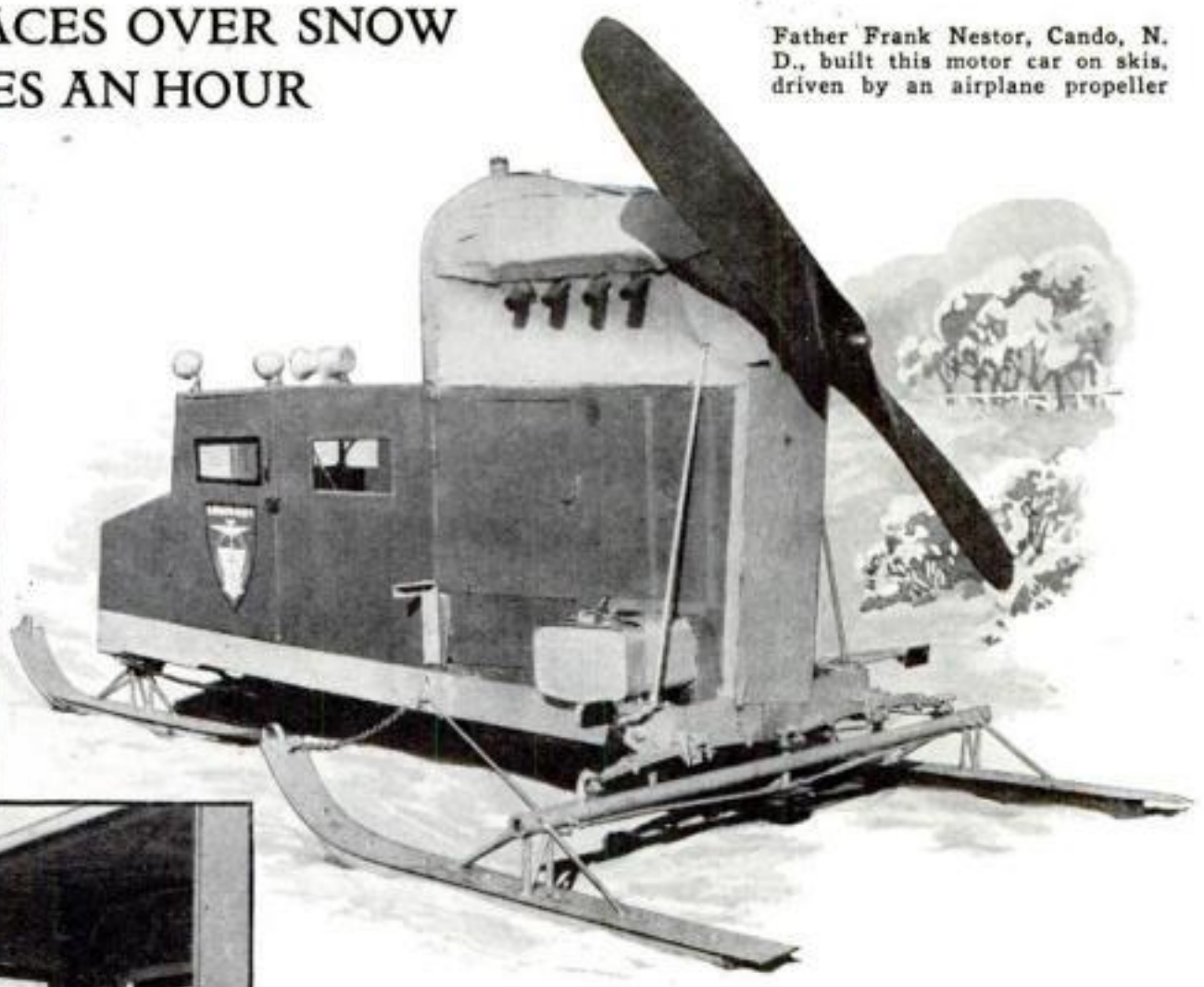
A toothbrush that carries its own paste is now on the market. When the tube on its back is squeezed, paste is forced between the bristles. A fitting permits substitution of another tube when the first is used up.

STAND HOLDS NEW TUBA FOR PLAYER

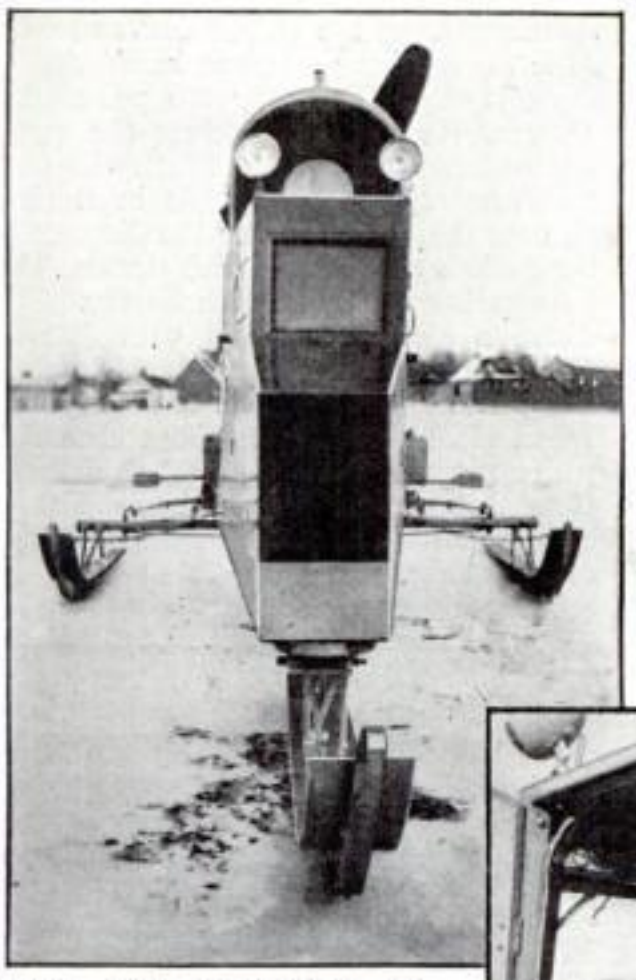
Movie patrons complained that his big brass tuba blocked their view—so Rudolph Dougherty, Portland, Ore., orchestra player, invented a new kind of horn that would boom impressively but stay out of the way. He found that the new instrument also eased his own work. Formerly he had to untangle himself from the tuba's coils to double on the bass viol, but the horn he invented may be played on a rest at his side. He has received orders for duplicates of the instrument.

Rudolph Dougherty, Portland, Ore., with tuba of a strange design he invented

AUTO ON SKIS RACES OVER SNOW AT 100 MILES AN HOUR



Father Frank Nestor, Cando, N. D., built this motor car on skis, driven by an airplane propeller



Above, note streamlining of "snow-boat." At right, interior of the machine's control cabin

When snow-blocked roads hindered Father Frank Nestor, of Cando, N. D., from visiting his outlying parishes during the winter months, he determined to build a machine that would be proof against unfavorable weather. An opportunity came to purchase a good 100-horsepower airplane engine secondhand, and around this Father Nestor constructed the remarkable air-propelled vehicle that he calls his "snow-boat." On packed snow or ice the slender streamlined vehicle can travel at a speed of 100 miles an hour.

Mechanics of a Cando garage, where the machine was built, donated their services and helped solve some of the technical problems. The body rests upon three hickory runners with spring steel shoes, backed by wide steel skis in case the runners should break through the snow. Steering is accomplished through the front runner.

The driver's cab suggests that of an automobile, with its steering wheel, foot accelerator, and spark and choke controls. Also on the instrument board are switches for a pair of headlights, and a horn button. Both horn and lights are mounted on the roof of the cab. The driver sees his way through a square windshield, equipped with a wiper that keeps it clear when the vehicle is used during a snowstorm.

POWER FROM NIAGARA TO LIGHT NEW YORK

For the first time, electric power generated at Niagara Falls will help to light New York City when a superpower transmission line is completed. Permission for the erection of the last link between Hudson, N. Y., and New York City has been granted by state authorities.

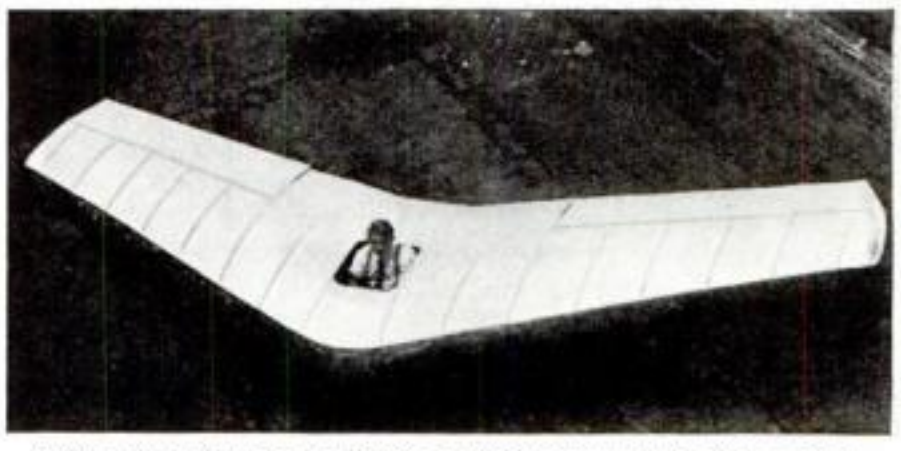
TWO-EYED CAMERA TO TIME RACES

This two-eyed camera, set going by starter's gun, will time Olympic races at Los Angeles

A new two-eyed camera will make its debut as an experimental timing device when the 1932 Olympic Games are held in Los Angeles, Calif. In the event of disputes as to the timing, this machine is expected to settle the controversy. One of its lenses makes a motion picture of the finish of a race; the other is trained upon a stop watch. These two images are automatically combined so that the finished picture shows the image of the watch and the exact time on each "frame" of the motion picture. The starter's gun sets the timing camera in action, so that there is small possibility of inaccurate timing. If the camera proves successful at Los Angeles it will be used to time other events.

THIS TAILLESS GLIDER IS NOTHING BUT WING

Unusual among small flying craft is a tailless power glider designed by two brothers of Salzburg, Austria. Built with their summer earnings from work on a farm, it is all wing and the pilot sits in a cut-out section of its upper surface. A tiny motor is said to propel the machine at fifty-mile-an-hour speed.



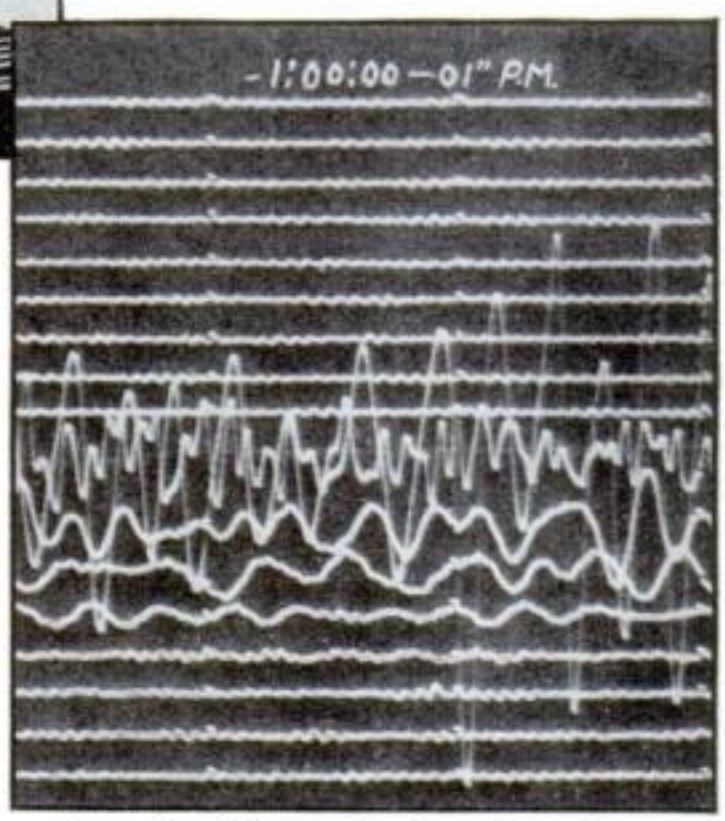
Two young Austrian enthusiasts built this unusual glider which is tailless and consists only of a wing in which pilot rides

Circles Plotted on Globe Mark Point of Quake's Origin

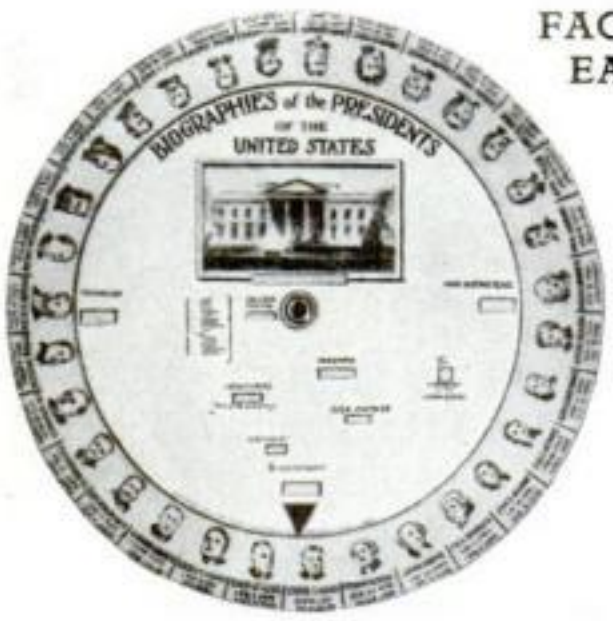
Tracing circles on a globe, Coast and Geodetic Survey experts quickly point to the exact spot at which an earthquake occurred. Distant stations furnish data

HOURS before radio or cable reports the destruction of a city by earthquake, seismologists of the U. S. Coast and Geodetic Survey have advance knowledge of the calamity. How they can point on a globe to the very spot where the quake occurred is shown in the illustrations.

Seismograph records made at stations all over the country show the distance of the quake's origin from each station. This information is wired to the Survey office, where a globe is marked with dots to represent each station and with parallels and meridians of latitude and longitude. When circles are drawn about each dot, with a radius equal to the quake's distance from that station, the point where three or more circles intersect marks the origin of the quake.



News of a violent earthquake, such as the one recorded on this seismogram, is rushed by wire to the U. S. Coast and Geodetic Survey office, Washington



FACTS ABOUT PRESIDENTS EASILY FOUND ON CHART

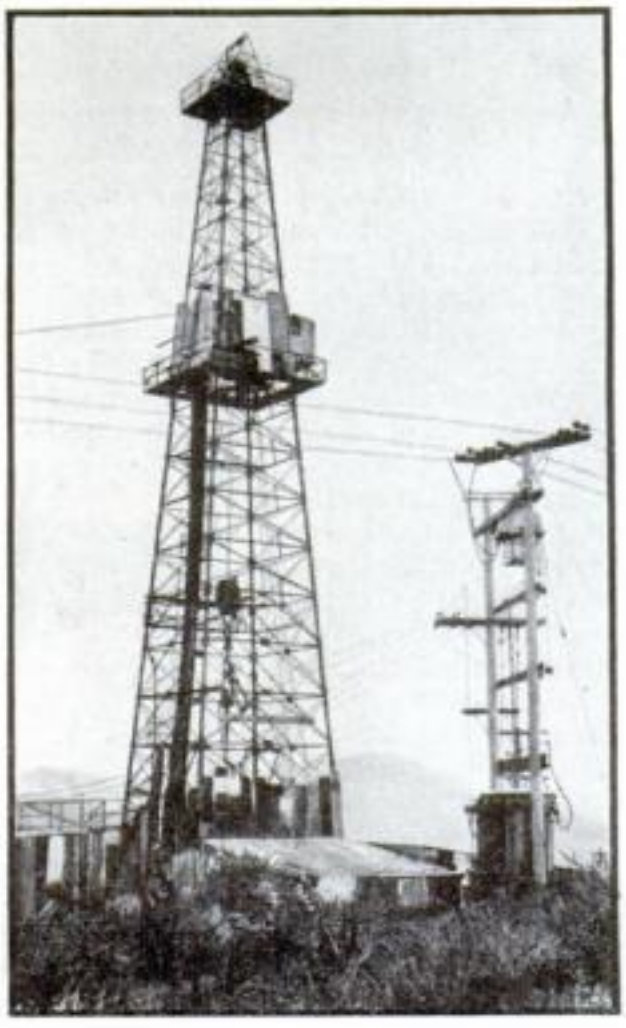
STUDENTS of history have all the lives of the Presidents at their finger tips, in a new mechanical biography. By turning the pointer beneath the cardboard wheel to any one of them, from Washington to Hoover, his date of birth, birthplace, term of office, and other varied bits of information are brought into view in slots on the wheel. Similar charts, giving biographical facts in the lives of any other selected group of distinguished men, or giving historical or geographical information, could easily be made.

ELECTRIC POWER SINKS WORLD'S DEEPEST WELL

HERE is a picture of the deepest oil well in the world, the shaft officially known as "C. C. M. O. Hobson 9-2" at Seacliff, Calif. As told not long ago (P.S. M., Dec. '31, p. 20), it pierces the earth to a depth of 10,030 feet. Electric power drilled the well, and the transformer installation may be seen on the derrick at right; also visible is the terminal pole of the transmission line that supplied the necessary electric current.

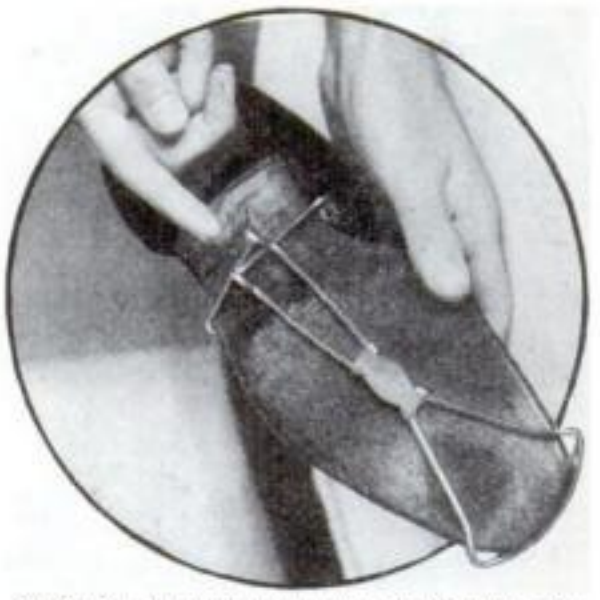
YOUNG FLYER TO GET ADVICE BY RADIO

SOON novices may take airplanes and gliders into the air and learn to fly them under instructions sent by radio from teachers on the ground. This plan was revealed recently when a Leroy, N. Y., man applied for authority to erect a 1,000-watt short-wave transmitting station for the purpose. Some of the terrors of the first solo flight may be banished for the inexperienced pilot, it is predicted, when he hears in his headphones the reassuring words of advice from his teacher.



WIRE TREE LETS SHOE DRY OUT QUICKLY

DAMP shoes dry without wrinkling or losing their shape, it is said, when a pair of new wire forms are snapped on them. Compact and simple, these devices are designed to replace old-fashioned shoe trees of wood. Since there is nothing inside the shoe, it can dry without delay.



This wire form snaps to toe and instep of a wet shoe and holds it in shape as it dries

CLAMP AIDS IN PLANING

Sliding wedge, in self-adjusting clamp, holds board fast for planing

BOARDS of any thickness are locked upright and rigid upon the workbench by an ingenious new clamp. Thus they are held without slipping while being planed. The simple holder is said not to mar the board in any way. Its secret is a sliding wedge that grips the work. The clamp resembles some homemade devices artisans have designed for themselves, but this is said to be the first made on a commercial scale.

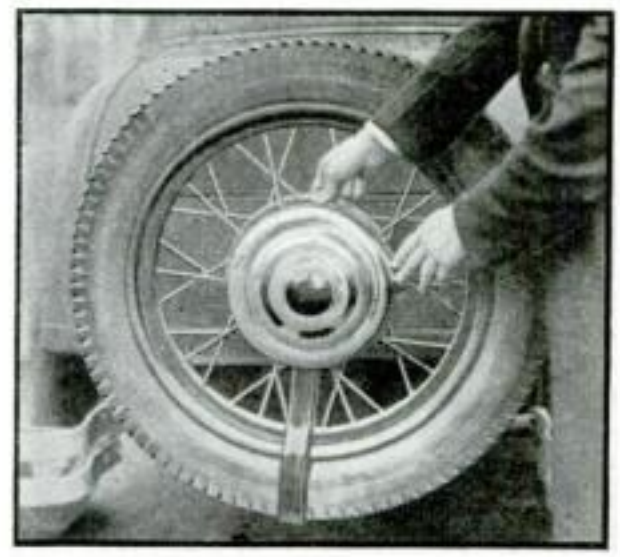
STATUES SHOW HOW PORCELAIN IS MADE

A MASTER craftsman in porcelain, William Leber of Berlin, Germany, has just completed an unusual series of figures that depict the porcelain industry itself. Placed on exhibition, they have been admired both as works of art and as faithful pictures of manufacturing operations with which Leber proves his entire familiarity. Processes depicted in miniature include practically everything connected with the industry from mixing the materials, modeling and pressing the figures, glazing the porcelain (shown in the accompanying photograph, at right), to putting it into the ovens for the final operation of baking.

These artistic figures are part of series modeled to show various steps in the porcelain industry

WIRE REPLACES WAX IN NEW DICTATING MACHINE

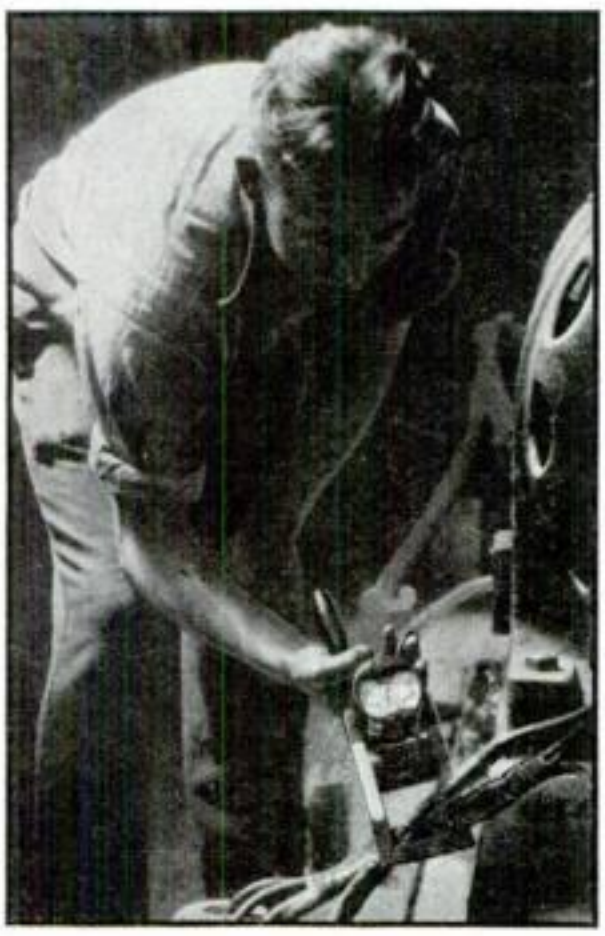
UNUSUALLY clear reproduction is claimed for a new type of dictating machine invented in Germany. In this device the fluctuations of a speaker's voice, conveyed electrically to electromagnets, leave a moving steel wire traveling through them more or less strongly magnetized according to the intensity of the voice at each instant. To play back the record, the wire is passed through a similar machine where the reverse process takes place and the voice is heard in a pair of headphones. The wire may then be run through a demagnetizer and used again. Wax records are dispensed with, since the wire takes their place. The wire is made of an alloy the nature of which the inventor is keeping secret, but upon which, he says, the success of his device depends. The machine is shown above.



HUB LIGHTS FOR CAR

HUB lamps for automobiles are now on the market. Furnished in red and green, they ornament the car and make it more easily seen at a crossroad. Hub lamps of the same type for the spare wheel, usually mounted at the rear of an automobile, as shown in the photograph above, serve as parking or tail lights.

AMMETER USED WITHOUT BREAKING CONNECTION



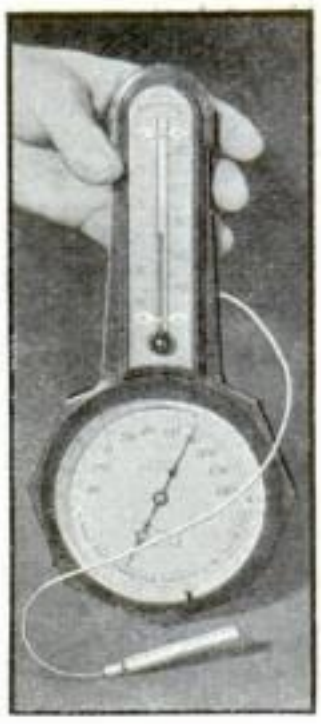
Ammeter like pliers slips around wire to measure current without breaking connection

ELECTRIC current flowing in a wire is measured without need of breaking the connection to insert an instrument, with a new ammeter that merely clips over the wire. Shaped like a pair of pliers, it may be operated with one hand. It acts upon the principle of a transformer, since alternating currents in the wire being tested induce a current in the instrument. This actuates the needle on a standard ammeter dial, as shown in the photo at the left.

TYPEWRITER LEGS HOLD IT ON LAP

LEGS for your portable typewriter, provided in a new attachment, make it possible to type with the machine held conveniently in the lap. When they are not in use the legs fold flat against the base. The device is the invention of a Finnish writer now living in the United States. It is particularly useful to reporters at sporting events.

GAGES COLD IN AND OUT



A NEW instrument for the home tells the temperature both indoors and out. When it is placed in any room, the temperature in the immediate vicinity is read on a conventional bulb thermometer. Below is the dial of another thermometer with tubing long enough for the actuating bulb to be put outdoors.

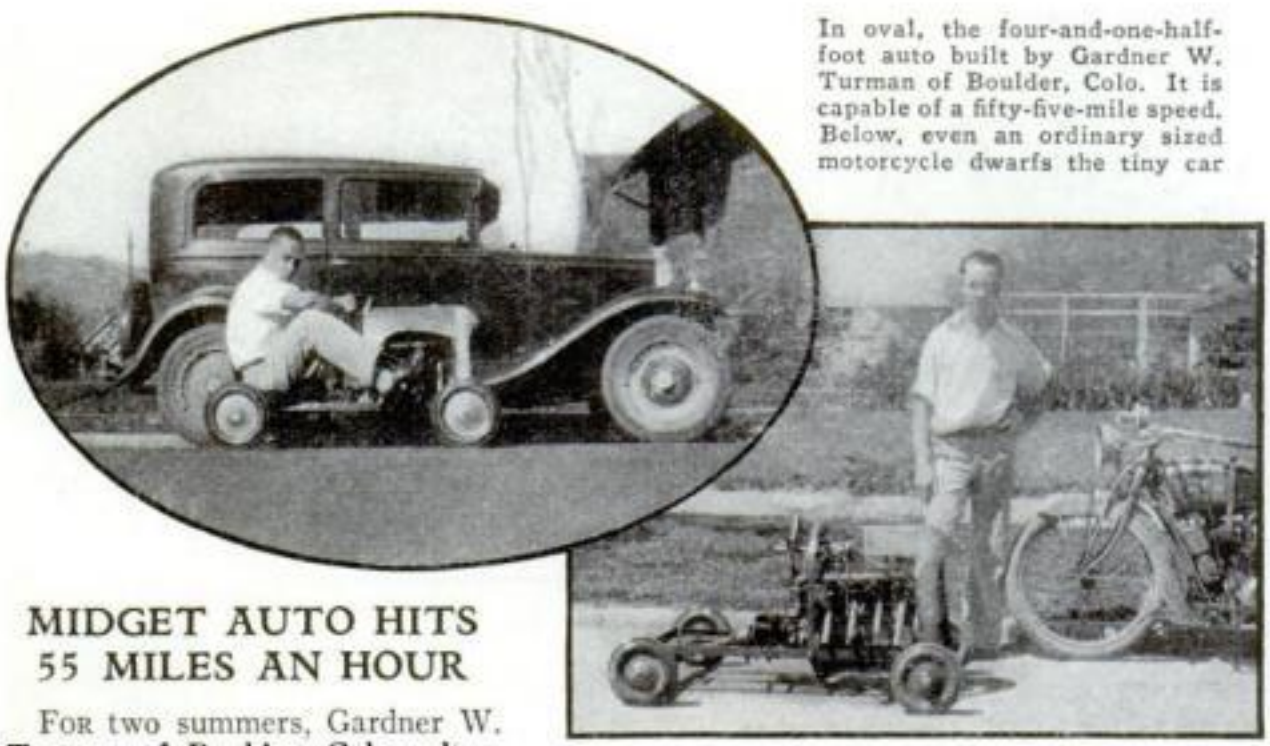
TINY UMBRELLA SHIELDS MIKE

EVEN the radio microphone gets its umbrella when rain threatens an outdoor broadcast in England. A tiny shield only a few inches in diameter effectively protects the delicate instrument.

This tiny umbrella was designed to protect the microphone while broadcasting outdoors in case a sudden rainstorm came up and the program could not be stopped and postponed

OLD CAVE MEN LIKED THEIR WOMEN FAT

WHEN men lived in caves, their ideal of feminine beauty bore little resemblance to modern standards. Pictures and sculptures on cave walls indicate, according to J. T. Russell of the Smithsonian Institution, that prehistoric men preferred women almost as fat as they were tall.



In oval, the four-and-one-half-foot auto built by Gardner W. Turman of Boulder, Colo. It is capable of a fifty-five-mile speed. Below, even an ordinary sized motorcycle dwarfs the tiny car

MIDGET AUTO HITS 55 MILES AN HOUR

FOR two summers, Gardner W. Turman of Boulder, Colo., alternate boy in the 1929 Edison contest, spent his spare time in his workshop, and the result was a midget automobile that can carry its single passenger as fast as fifty-five miles an hour. Even a motorcyle dwarfs the tiny machine, for it measures only four and a half feet long. A four-cylinder motorcycle engine drives it. The car has three speeds, with a direct bevel gear drive from the engine to the one-foot wheels. No differential is needed.

SNAP LIGHT PLANE AT TOP OF ITS SPEED

CLOSE coöperation between pilot and camera man produced the remarkable action photograph of a light plane of the powered glider type in full flight, shown below. When the man with the camera, a Hudson, O., amateur photographer, was ready, the pilot swooped straight at him. Just as the camera clicked, the machine zoomed upward and over his head. The picture even shows the pilot leaning out to gage the distance. This experiment demonstrated the maneuverability of the light plane, for a split-second delay in response to the controls might have killed both participants.

Remarkable photo of light plane snapped just before it zoomed over the cameraman's head

RAZOR CAN TRIM HAIR

A CLEVER attachment for a standard make of safety razor enables any man to trim his hair in the manner of a professional barber, it is said. Drawn downward against the hair, the razor blade is given an increasing tilt by two metal rockers, and produces a "feather edge."

Plants dipped in this rubber product are protected from disease and growth stimulated

USE RUBBER SOLUTION TO PROTECT PLANTS

A NEW rubber product has been invented to protect plants in storage during the winter months. Dipped in this solution, the stalks are coated with rubber a thousandth of an inch thick, which protects them from diseases of other plants and tends to kill minute germs or insects by shutting off their air supply. The rubber coating holds the plants back two or three days after they are planted; but when they begin to grow they do so more rapidly than untreated plants, manufacturers of the solution claim.

USE PHONOGRAPH AS AN ALARM CLOCK

A NOVEL attachment for the phonograph by which a heavy sleeper may be aroused at any hour he wishes by soft music, was recently shown in London, England. The alarm-clock device is set at the desired hour, and wound. A brake on the turntable of the phonograph is released at the set hour by a slight pull from the alarm key of the clock.

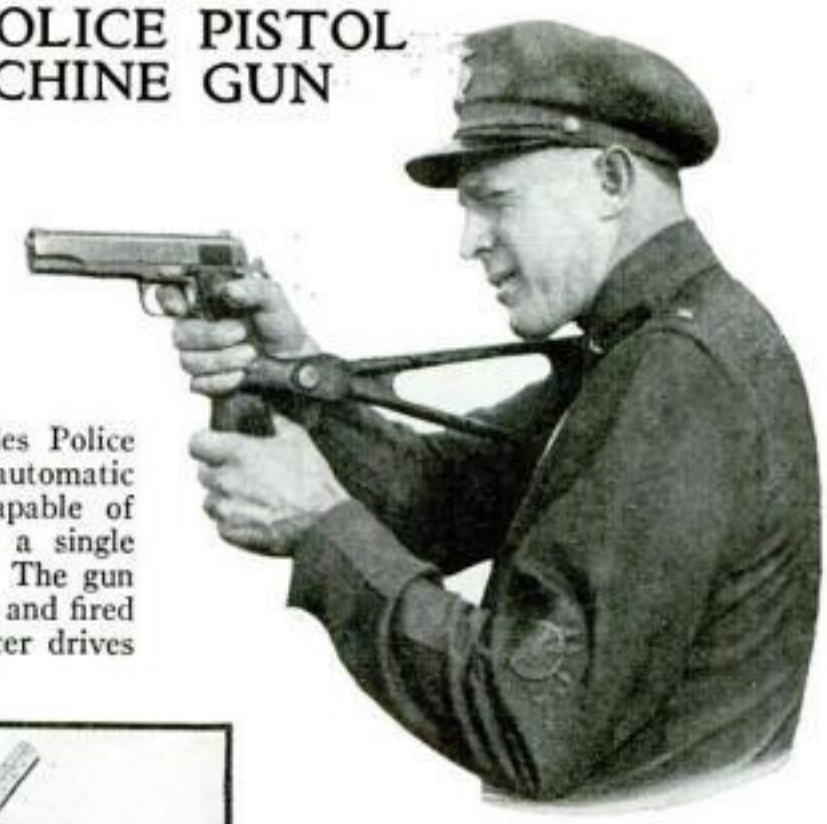
PISTOL FIRES RED PAINT AT FLEEING AUTO

SO THAT gangsters and hit-and-run drivers cannot escape pursuing police cars in crowded city streets, a St. Louis, Mo., inventor has devised a pistol which shoots a small celluloid shell about the size of a hen's egg. Upon hitting the body of a fleeing automobile it creates a large splash of red dye. This identifies the car as one wanted by the police. The barrel of the pistol is about two inches in diameter, and the projecting mechanism is a spring which will shoot the shell over 900 feet. The nose of the shell is soft rubber, underneath which is a pin valve that releases the dye.

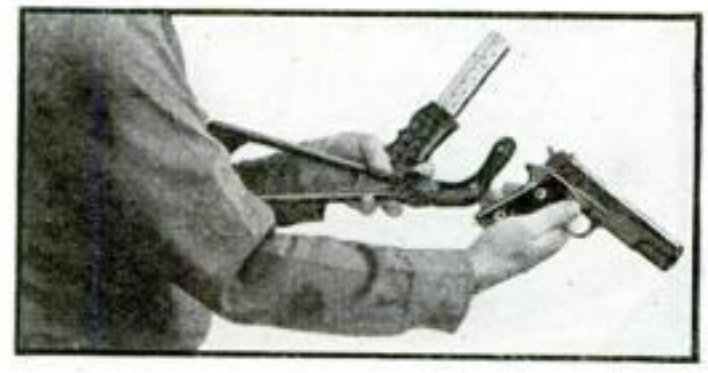
St. Louis police have a new pistol that fires a red paint bomb at a fleeing automobile

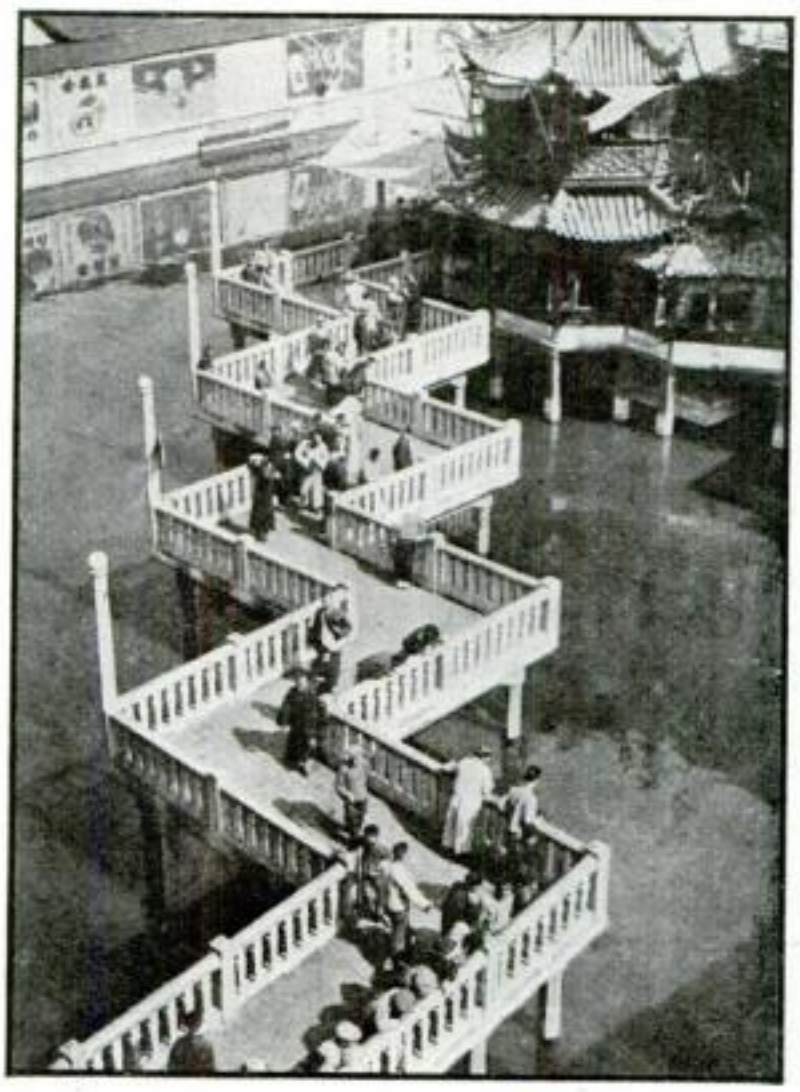
AUTOMATIC POLICE PISTOL IS REAL MACHINE GUN

GANGSTERS fear the wail of the motorcycle policeman's siren in a number of California cities, where officers now meet the rattle of a machine gun with a deadly fire. Their weapon, the invention of Lieutenant Jack Lyons of the Los Angeles Police Motor Squad, converts an automatic pistol into a machine gun capable of firing twenty-two shots from a single clip in less than five seconds. The gun can be braced against the body and fired with a single hand as the officer drives along; or it may be fired like a shotgun, using both hands. The long cartridge clip also is a handgrip.



Los Angeles' Motor Squad is now equipped with an automatic pistol that will fire twenty-two shots in five seconds





This zig-zag bridge meanders leisurely across a lake in China and leads the stroller to an attractive tearoom

CHINA NOW HAS ZIG-ZAG BRIDGE

ODDEST of bridges in the Orient is a zig-zag structure just completed in China. It meanders across a lake in Shanghai, China, leading to a tea house on the opposite shore. In the hospitable corners of the bridge strolling pedestrians gather and pause for friendly conversation.

SEVEN BOYS PLAY BIG HARMONICA

SEVEN boys are needed to play a huge harmonica recently demonstrated at Detroit, Mich., and which is declared to be the largest of its kind in the world. It measures eight feet in length, giving sufficient space for each performer to render the part assigned to him in music orchestrated especially for the big instrument. There are 770 notes in all on the scale of the gigantic mouth organ.

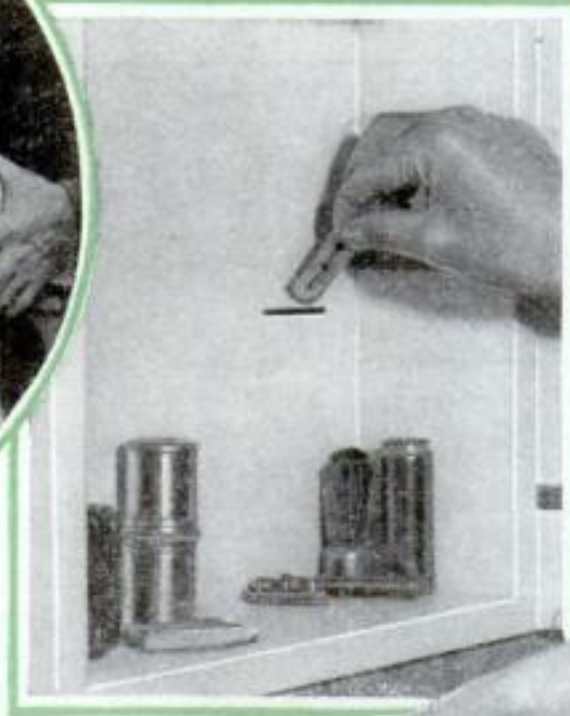
At right is the world's biggest harmonica. Seven boys are required to play special music on the giant mouth organ

Household Tools *to Speed Home Work*

VERSATILE TONGS. Useful in the kitchen are these tongs which serve many purposes from grasping hot potatoes to lifting eggs out of boiling water. Also at one end there is a handy bottle opener

ROLLING FOOT REST. The old-time American favorite, the rocking-chair, is now provided with a rolling foot rest that is padded and hinged to the chair. The forward end is supported upon smooth-running rollers

DRIES HAIR QUICKLY. This new hair drier can be used with an ordinary gas plate. When the curved housing of sheet metal is set upon the burner, it directs outward a stream of hot air which, striking the hair, quickly dries it



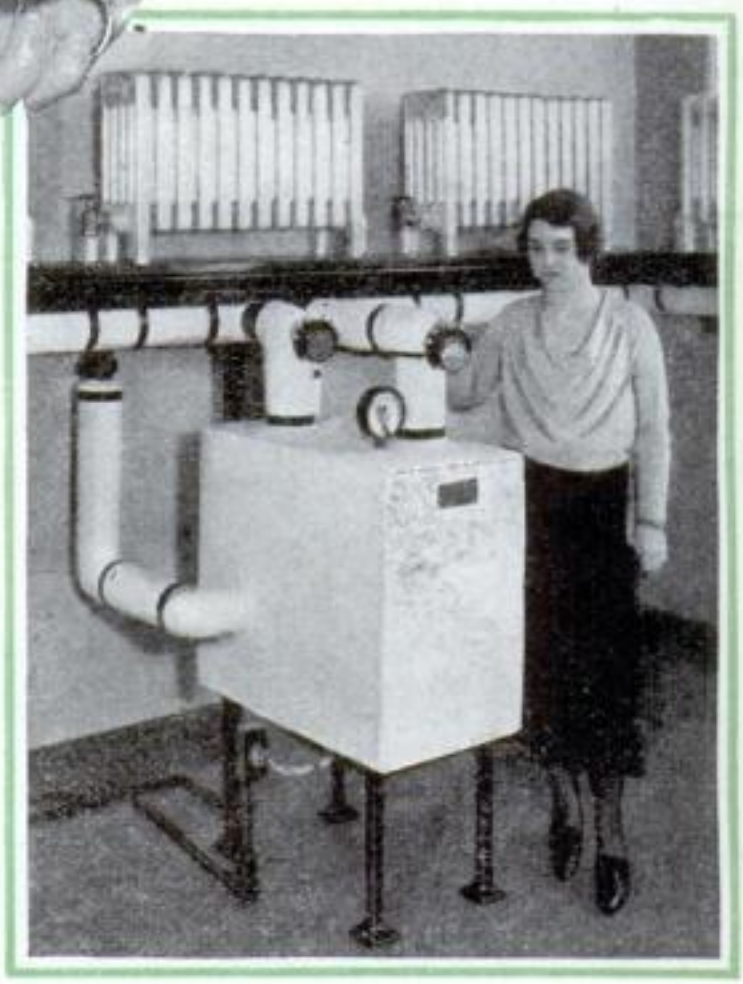
SLOT FOR USED RAZOR BLADES. Disposal of worn-out safety razor blades is provided for when a compartment with a slotted opening is built into the bathroom wall

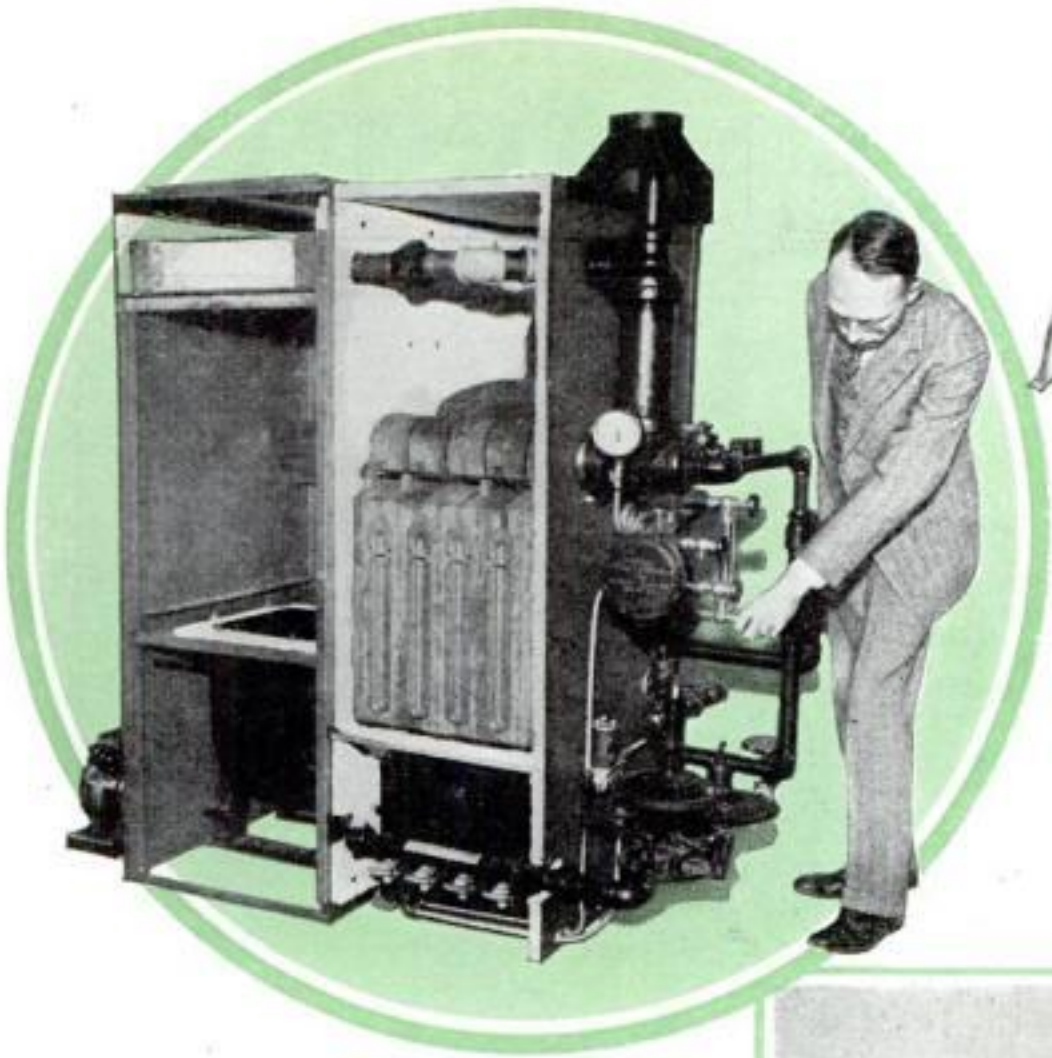
TABLELEG ASH RECEIVER. This bridge table's hollow legs are fitted with ash receivers

THEY SAVE YOUR HANDS. Especially designed to aid in washing clothes are the tongs shown below. Their grip will not harm fragile fabrics, it is said

TURNS FLAPJACKS. No skill is needed to flip over flapjacks with this automatic turner. When slipped under a pancake and the handle squeezed, the cake is turned

ELECTRIC BOILER. Photo at right shows a demonstration set-up of a new electric boiler that can be connected to radiators and to the regular house current supply

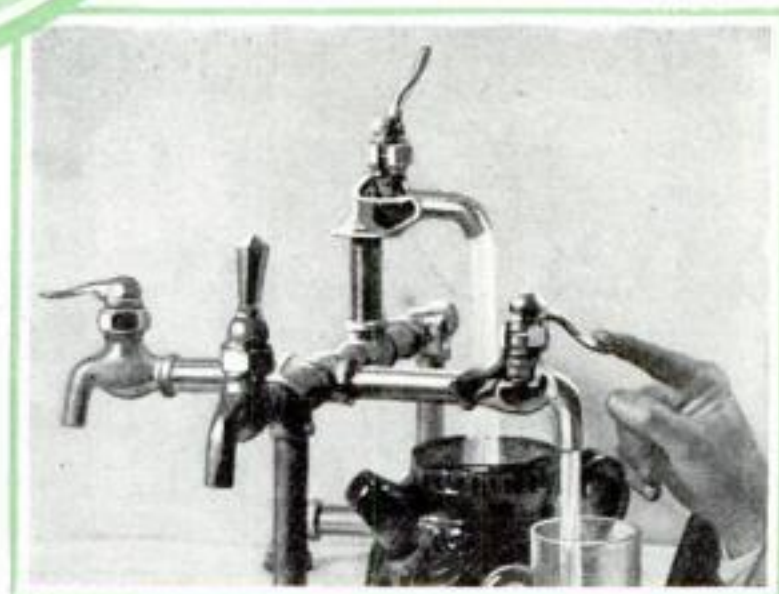




HOT OR COLD. The plant shown at left can be operated as a heating unit in the winter and then it can be adjusted as a refrigerator to keep the house cool during the summer months

GRAPEFRUIT HOLDER. Half a grapefruit can't roll around the plate when it is held by this attractive server

COFFEE CUPS THAT FIT. In order to save space on shelves or cupboard hooks these coffee cups are made so they nest together, held by center rim

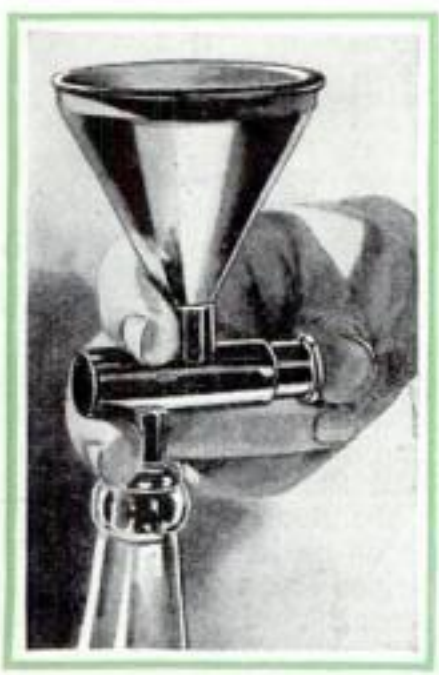


TWO-WAY FAUCET. At left a new faucet that, when the lever is pressed down, automatically closes itself as soon as lever is released. When lever is raised, faucet remains open until lever is again pushed into neutral position

NEW HAND TELEPHONE SET. The base of this recently designed hand telephone set has no projecting parts. It may be set on a table or attached as a fixture to wall. Raising receiver-transmitter makes connection

SUGAR METER. Guesswork in mixing ingredients in the kitchen is unnecessary if the meter shown at left is used. Pressing the plunger releases a tablespoonful of sugar

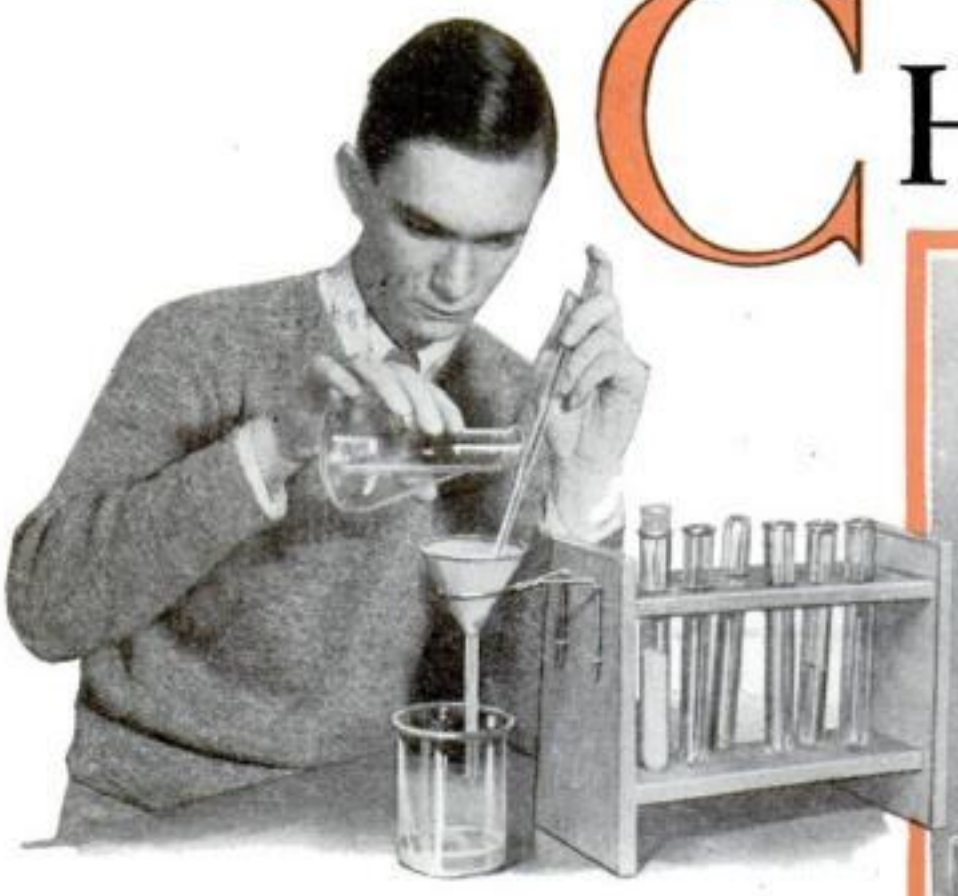
WIPER ATTACHED TO SASH. Permanently attached to a window sash is a new metal window wiper with padded arms that run in slots on the frame and clean the surface at one sweep across it



DOORBELL AND ALARM. A combination lock for the front door contains also a doorbell and a burglar alarm. Any tampering with the lock sets off the alarm

THREE-IN-ONE TOOL. The latest thing in combination tools is this pot lifter, can opener, and bottle decapper. Its two curved and spreading prongs give it a firm grip when a hot pan is moved from stove

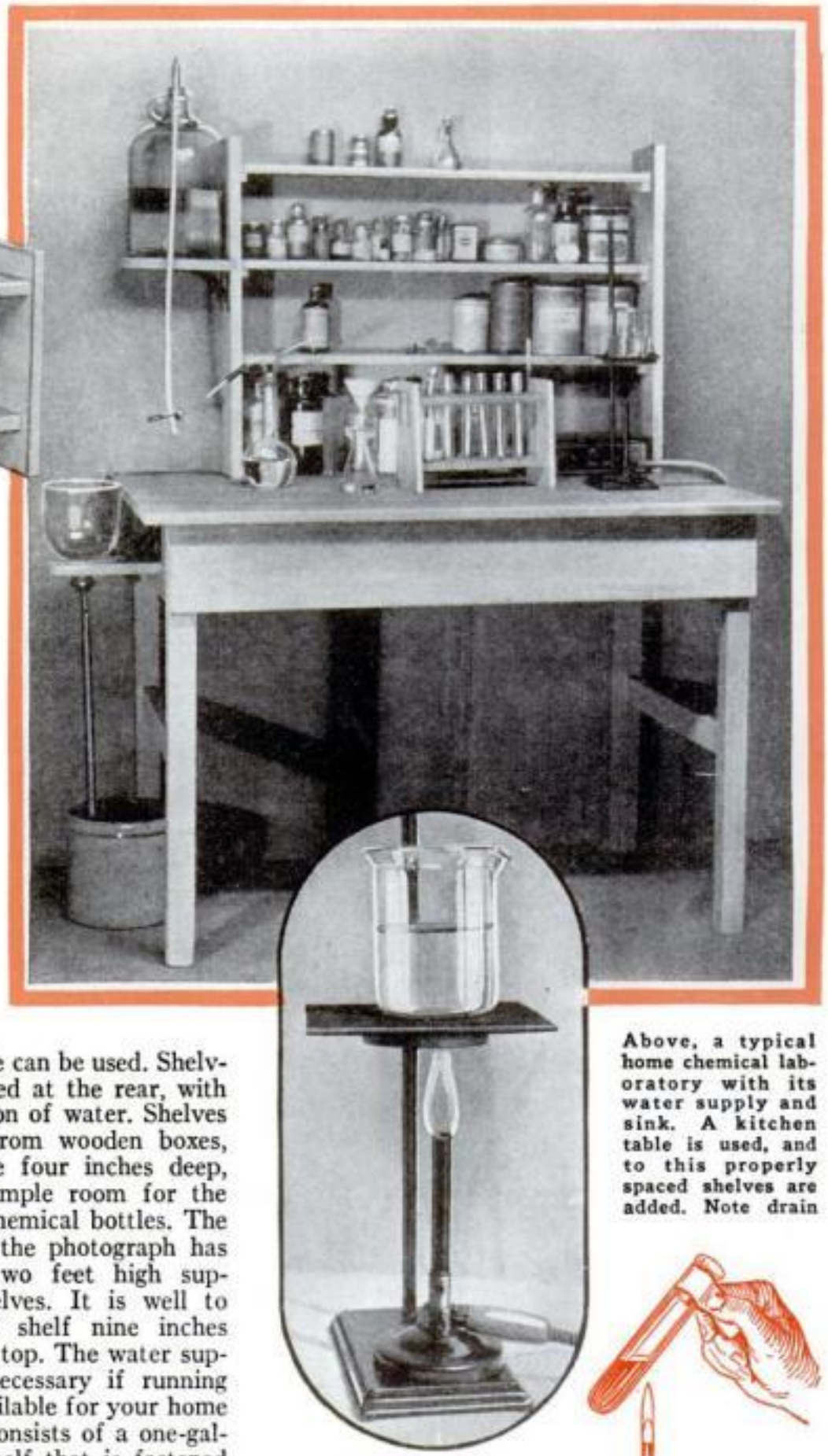
CHEMISTRY:



In using the filter, which is attached to the end of the test tube rack, liquid is poured down stirring rod into funnel with mouth of flask touching the rod

How to Set Up Your Laboratory

By RAYMOND B. WAILES



Above, a typical home chemical laboratory with its water supply and sink. A kitchen table is used, and to this properly spaced shelves are added. Note drain

Above, beakers can be heated on an iron plate supported over Bunsen burner. At right, correct way to hold a test tube over a flame, heating top of liquid first

WITH simple equipment requiring surprisingly little financial outlay, you can build in your home a small chemical laboratory that will provide a fascinating hobby.

Here you may amaze your friends with seemingly magical chemical tricks, as by the manufacture of paint that shines in the dark or of writing inks that disappear unless the secret of bringing them back is known. You can manufacture useful things for the home, as soap or liquid court plaster. You can test gold rings and ivory piano keys to see whether they are genuine. If you wish, you can investigate the chemical processes used in industry, with the ever-present possibility of an important discovery. To the real dyed-in-the-wool experimenter, chemicals in themselves are intriguing, and a beautifully colored precipitate or a startling formation of crystals is its own reward for the trouble of preparation.

First you will need a suitable workroom —and it would be well to consult the lady of the house before usurping the bathroom or the laundry tubs. Running water is an advantage, but it is not essential. An attic, a corner of the cellar, or a spare room will do well.

You will require a chemical bench at which various chemicals and apparatus may be stored, and a working space provided for the setting up of apparatus.

In the making of a chemical bench, an old kitchen table can be used. Shelving can be placed at the rear, with room for a gallon of water. Shelves can be made from wooden boxes, and if they are four inches deep, there will be ample room for the usual sizes of chemical bottles. The table shown in the photograph has side uprights two feet high supporting the shelves. It is well to space the first shelf nine inches above the table top. The water supply shown is necessary if running water is not available for your home laboratory. It consists of a one-gallon jug on a shelf that is fastened to the uprights by means of shelf brackets. A glass and rubber tube with pinch clamp is used to siphon the water from the jug.

The drain, or sink, is made from the cut-off top of a large bottle inserted in a hole in a shelf that is fastened to the side board of the table with shelf brackets. Fitted with a cork, a glass tube, and a rubber drainpipe that feeds into an earthenware crock below, this means of waste disposal will be found well suited to the chemical bench. If spent acids are poured into the glass sink, a copious flow of water from the water supply above can be directed into it, diluting it and washing the last traces into the crock. After diluting well with water, the crock can be emptied.

If gas is available at the chemical bench, many of the experimenter's troubles are over. Lacking this perfect fuel, alcohol lamps or a small electric stove can be used. The latter is not economical when test tubes are to be heated.

Beakers and flasks of liquids can be heated over the Bunsen burner by supporting them on an iron plate or a wire gauze on a tripod or a ringstand, both of which are stocked by dealers in chemical apparatus. With the ordinary Bunsen

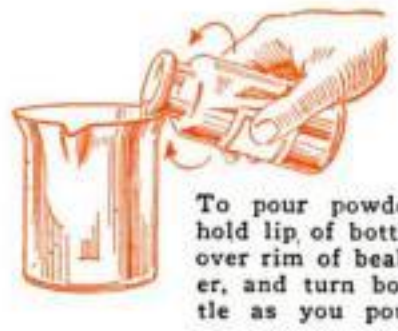
An Exciting *and* Profitable Hobby

burner, the tripod should be nine inches high. The ringstand with its ring is adjustable. If an alcohol lamp is used as the source of heat, the vessel to be heated should be placed so that its bottom is just beyond the tip of the flame.

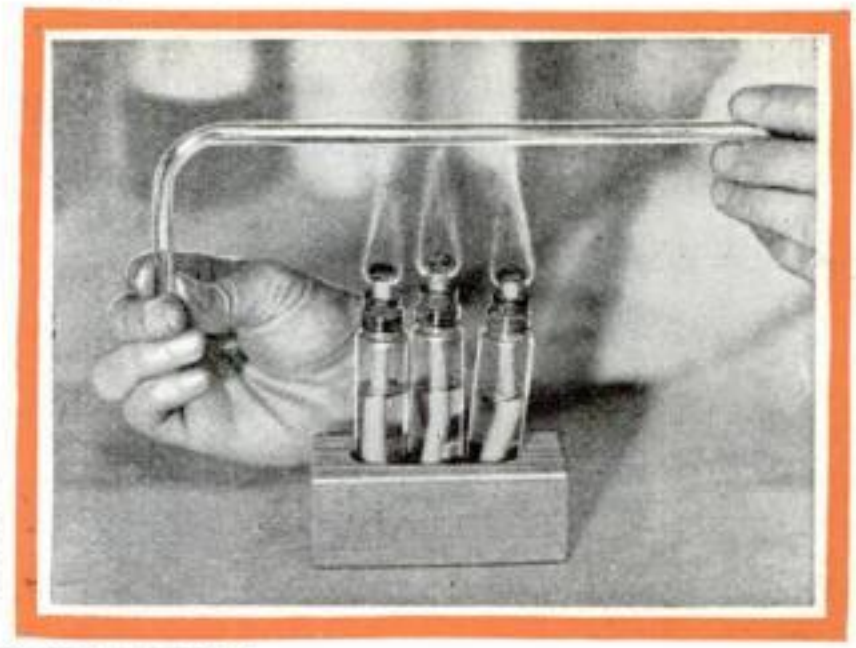
In heating test tubes containing liquids, hold the tube away from the face and heat only the upper portion of the liquid at first, slightly shaking the tube until boiling occurs. In this manner, many test tube breakages can be eliminated. The test tube can be held by a metal test tube holder or a girdle of heavy paper.

GLASS tubing, constantly used in chemical experiments, can be cut to length by drawing a three-cornered file across the tube once or twice and then breaking the tube as one would a stick of candy, holding the filed side away from you. If the end of a glass tube is introduced in a flame and heated slowly, the sharp edges will melt and become round, giving a "fire-polished" edge.

If glass tubing is softened and bent, using a single Bunsen flame or an alcohol lamp, the tube will flatten and constrict itself at the bend. By equipping a Bunsen burner with a flame spreader, glass tubing can be heated and softened for two or three inches so that a perfect bend is possible.



To pour powder hold lip of bottle over rim of beaker, and turn bottle as you pour



Perfect bends in glass tubing can be made if the tube is heated over three homemade alcohol lamps in row. One lamp gives flattened bend

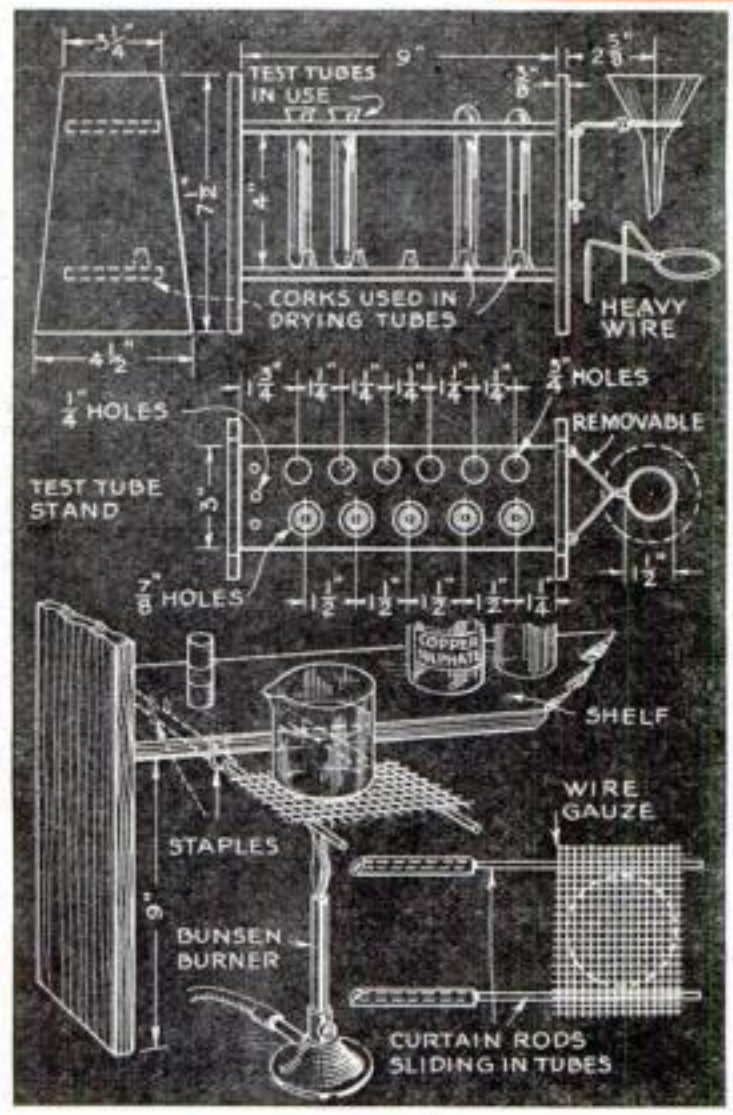
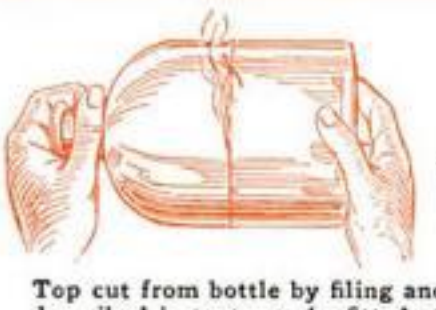


Diagram above will serve as a blueprint to give you right dimensions for tube rack and shelves

At left, bottles and retorts are fitted with corks having two holes, one for air intake, if it is intended to siphon out their contents



HOW TO CUT TOP FROM BOTTLE FOR SINK

Top cut from bottle by filing and burning, as described in text, can be fitted at end of work bench to serve as sink, as shown in upper photo. Rubber tube runs to drainage vessel

Those home laboratories without gas should be equipped with three little alcohol lamps inserted in a wooden block, for glass bending. Small medicine vials fitted with corks, metal or glass tubes, and round wicks make excellent alcohol lamps. They are arranged side by side, and the glass to be bent is placed at the tips of the flames, rotated until the glass has softened, and then bent to shape, reheating at times if necessary. The writer has produced perfect bends with three lamps set up as shown at the top of this page.

Bottles and large sizes of glass tubing may be cut in two by means of an electrically heated resistance wire or by filing a line around the bottle, wrapping a string about the filed line, soaking the string in alcohol, and lighting. When the flame goes out, hold the bottle under running water and usually it will crack along the filed line. Carborundum stone or emery cloth is then used to rub down the sharp edges. In this manner the sink for the chemical bench was made.

A SUPPORT for test tubes can be easily made from wooden boxes. The one shown here will take six tubes in the upright position and five tubes in an inverted position. In this latter position, tubes are dried after they have been washed and cleaned with a bottle brush. The test tubes most commonly used are six inches by three quarters of an inch. Three holes are also placed in the test tube rack for supporting stirring rods, which can be tubing with the ends closed by holding in a flame.

A useful attachment to the tube rack is a filtering support. This is made of heavy wire twisted as shown and attached to the test tube rack by inserting the prongs through screw eyes carried on one end of the rack.

Cork borers can be purchased from laboratory supply houses, or metal tubes of various diameters can be used as borers. Such tubes—as bean blowers, curtain rod tubes, and so on—can be sharpened at one end with a file, and with a pushing and rotating motion the sharpened tube passed through corks, leaving a clean hole. The cork plug should then be removed from the borer. When passing glass tubing through holes in corks, protect the hands from injury, for the glass may break if the hole is too small or if too much force is used.

You will require a wash bottle in many chemical manipulations. The sketch shows how this item can be made. A flask or bottle can be used.

A small photographer's balance with gram weights will be found handy in carrying out experiments where substances are called for in "parts." It should be sufficient to say that many formulas call for parts by weight, as sulphur two parts, iron one part. Here, two grams or twenty grams of sulphur can be weighed out and mixed with one *(Continued on page 133)*

RAYMOND J. BROWN, *Editor*
ARTHUR WAKELING, *Home Workshop Editor*
ALFRED P. LANE, *Technical Editor*
ALDEN P. ARMAGNAC, *Associate Editor*
SYDNEY OXBERRY, *Art Editor*

Editorial

POPULAR SCIENCE MONTHLY
Published Monthly by Popular Science Publishing Company, Inc., 381 Fourth Avenue, New York City. Single Copies Twenty-five Cents. In United States and Possessions, $2.50 the Year. In all other Countries, including Canada, $3.00 the Year.

The Need to Make Things

IF, BY some miracle, you could be transplanted backward in time to the days of our prehistoric ancestors, what would be the first thing you would do?

It makes no difference whether you are a banker, a farmer, a politician, or a factory worker, your first action, assuming that you didn't drop dead at the suddenness of the change, would be to search for food. The second would be to search for shelter both from the elements and from wild beasts. In other words, the two necessities of existence, which you now take so much for granted, would occupy your thoughts to the exclusion of everything else.

Guessing what you would do after that depends on the particular kind of primeval wilderness to which you were transplanted. You might, for example, find yourself in a time and location in the past when the struggle for existence was fierce. Getting food and shelter would, in that case, occupy every waking thought until you met death under the claws of some carnivorous beast. And you wouldn't last long, either, for only the exceptionally skillful in the art of self-preservation lived even to middle age under such difficult conditions.

On the other hand you might land in some clime and time where Nature had set up what closely approached an earthly paradise such as Robert Louis Stevenson said the South Sea Islands were before they were spoiled by the white man.

Could You Rest Forever?

With Nature supplying food in plenty, an absence of wild beasts, and a climate that made shelter unnecessary, your search for food would take only a small fraction of your waking hours. What would you do with the rest of your time? Not being a native South Sea Islander you would have great difficulty in accustoming yourself to a life of heavenly inaction. You might find yourself trying to organize an expedition to a neighboring island, attempting to develop bigger and better thatched huts, or endeavoring to grow larger and more succulent coconuts.

Every one of us is descended from a line of ancestors that, for thousands of centuries, used brain and muscle to work out new ideas and to turn them into actualities by the labor of the hands.

We have, in short, an inborn "skill hunger," a deep-rooted desire to work out new ideas, as our ancestors did, and to convert those ideas into physical being with our own hands.

Modern civilization has made it difficult for many of us to satisfy our inherited skill hunger to a normal extent. Mass production, desirable because it makes it possible for each of us to live better than the kings of old, unfortunately does not satisfy our skill hunger.

Compare, for example, the process of getting meat for dinner as practiced by our ancestors and as we practice it. Our ancestor pitted his skill in woodcraft against the keen protective senses of wild animals, and he got a real thrill out of the triumph that brought the animals to pot. We, on the other hand, get our dinners because we stand in front of machines and go through the same motions all day long or sit at desks and add up endless columns of figures.

Hobbies Answer This Urge

These jobs have to be done right, of course, but few of them require maximum mental exertion or any considerable amount of initiative.

Some of our skill hunger may be employed in fitting ourselves for better jobs, but even that cannot completely satisfy the urge.

How is it to be done? Considering the limitations imposed by modern civilization, how are we going to satisfy our inborn desire to develop ideas and turn them into something useful?

This growing desire to satisfy skill hunger undoubtedly is the basic reason for the perfectly astounding increase in interest people are taking in all forms of hobbies that revolve around the use of various kinds of tools in the home workshop. If you build a model coach, for instance, you satisfy your skill hunger just as thoroughly as did the old-time coachmaker who built the coach you are modeling. If you are building a ship model, a working model railroad, a beautiful piece of furniture, or any of the thousands of possible projects, you can revel in the perfection of detail after detail, in a most completely satisfying way.

The model coach builder will, of course, wonder how people can take an interest in model railways or home-built furniture. The home-built furniture fan and the model railway enthusiast will, in turn, consider that the stagecoach builder is wasting his time.

Do you, at the end of the day, feel a sort of vague, unsatisfied feeling lurking around in the shadows of your brain? It may be skill hunger and if it is, see what happens to it after a session with the hammer, saw, and try-square!

Easy Way to Test Ground Circuit

By JOHN CARR

HOW high is high and how long is long? Every radio beginner has asked himself that question when he has read the statement that best results are secured on distant stations with a high and long antenna. The trouble is, of course, that the terms "high" and "long" can be used only in a relative sense.

An antenna forty feet above the ground would be high in a community of one-story bungalows, yet an antenna of that height would be low if surrounded by steel buildings many stories high.

The same indefiniteness is a disturbing feature of other radio instructions. For example, it is common to specify a section of pipe driven into the earth as a good ground connection. Sometimes a three-foot length is suggested, sometimes a five-foot section.

As a matter of fact a piece of pipe only a foot long will serve as perfect ground if driven into earth that is perpetually damp, whereas a ten-foot pipe driven straight down into excessively dry and sandy soil may be quite ineffective.

If there is electric light service in your home, you have a perfect means of checking the effectiveness of the ground. In all ordinary electric lighting systems, one of the wires is virtually at ground potential, which means that there is no electrical voltage or pressure between that wire and the earth itself. The other wire is "live," which means that it always is at 110 volts pressure with respect to either the other wire or the ground itself.

Figure 2 shows a simple circuit for testing the efficiency of the ground connection. A single wire is connected to one prong of an electric plug. The other end of the wire is connected to one terminal of a porcelain type socket, the kind that has no exposed metal parts. Then another separate wire is connected with one end to the remaining terminal of the socket and the other to the pipe you have driven into the ground.

Place an electric bulb in the socket and push the plug into the nearest wall socket. If the light does not light at all, pull out the plug and insert it in the reversed position. If the light still fails to glow, you can be certain the ground will be rather ineffective for radio use. If, on the other hand, the light glows with normal brilliance with the plug in one of the two possible positions, you can be sure that the ground will give good radio results.

Remember that a ground which tests perfect in the wet, rainy season may be far from perfect after a long spell of dry weather.

Another feature of antenna installation that often worries the beginner is the arrangement of the lead-in to the set and the lightning arrester so that it will be electrically right and yet not an eyesore. Figure 1 illustrates a new device that simplifies these problems.

It combines an inside wall plate with a plug for the antenna and ground connections to the set, with external binding posts for the antenna and ground lead, together with a built-in lightning arrester. The construction is novel in that complete installation is accomplished just by boring or drilling one hole clear through the wall of the house.

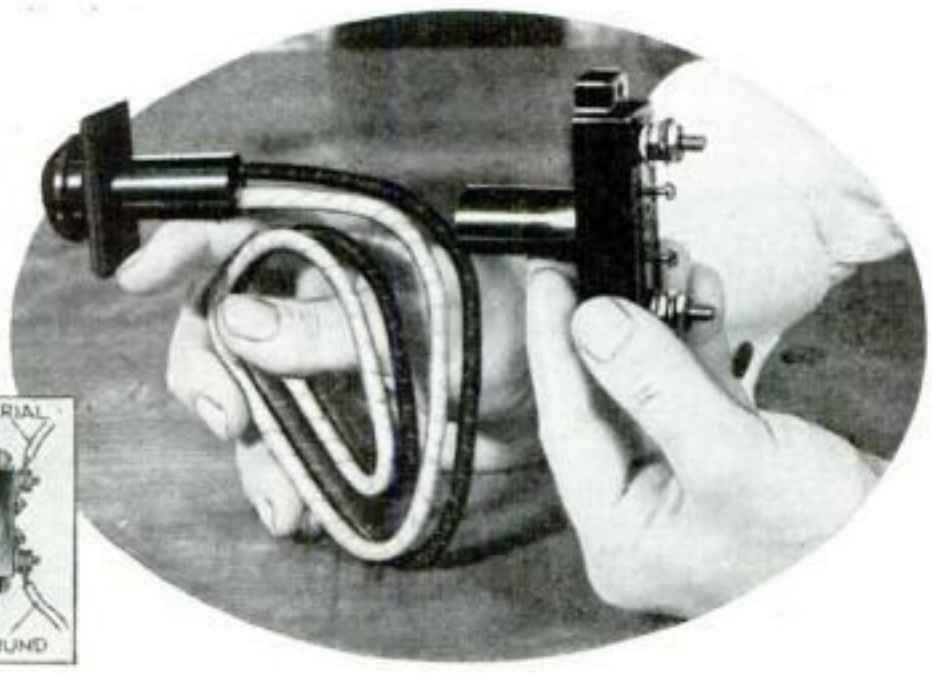
THE inside plate has two small prongs and is fitted with a pair of leads made of extra strong wire. After the hole is made, the ends of the wire are passed through, the surplus cut off, and the ends firmly clamped under the binding posts on the outdoor portion of the device. Then two screws are tightened. These serve to take up the slack in the lead wires and so pull the inside plate and the outside portion tightly against the inner and outer wall surfaces. The lead-in from the antenna and the wire to the ground connection are then attached to their respective binding posts and the job is done.

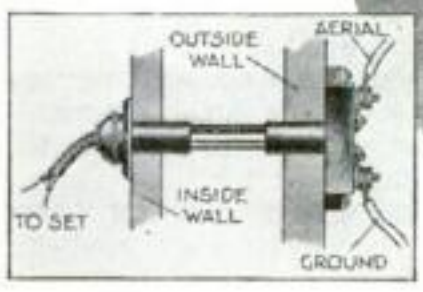
TEST YOUR GROUND CONNECTION

Fig. 2. One wire attached to plug and another to pipe, with light bulb between, will test ground circuit

HOW TO GET LEAD-IN RIGHT

Fig. 1. This new device combines an inside wall plate with a plug for the antenna and ground connection and is installed by drilling one hole





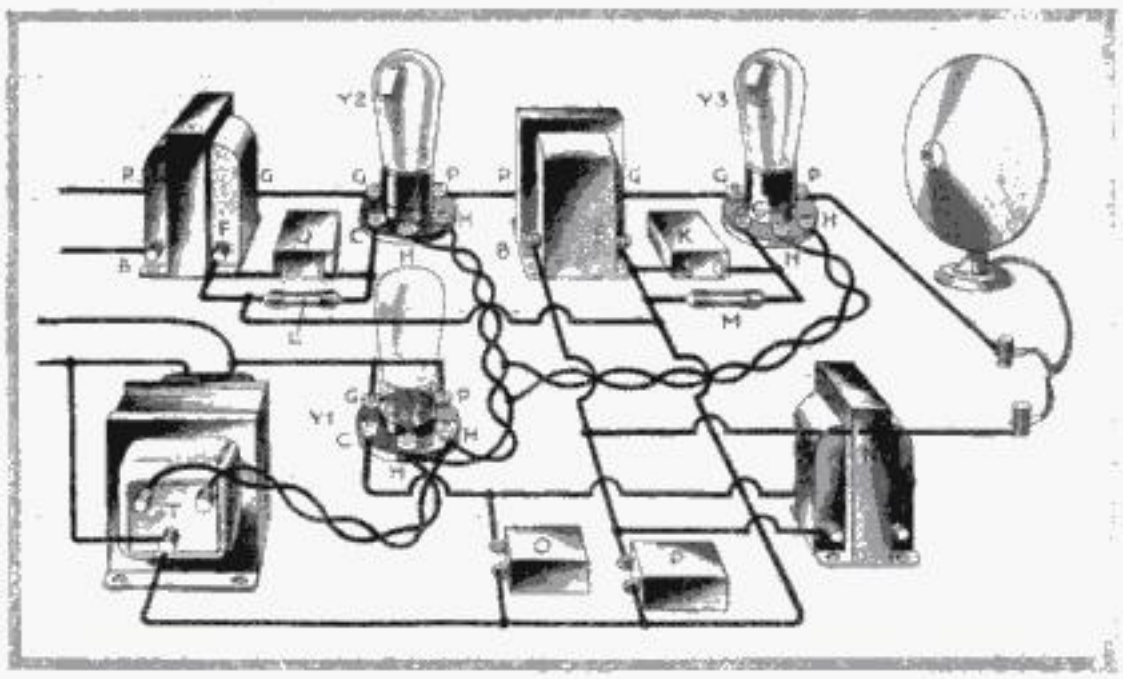
Figuring Grid Bias

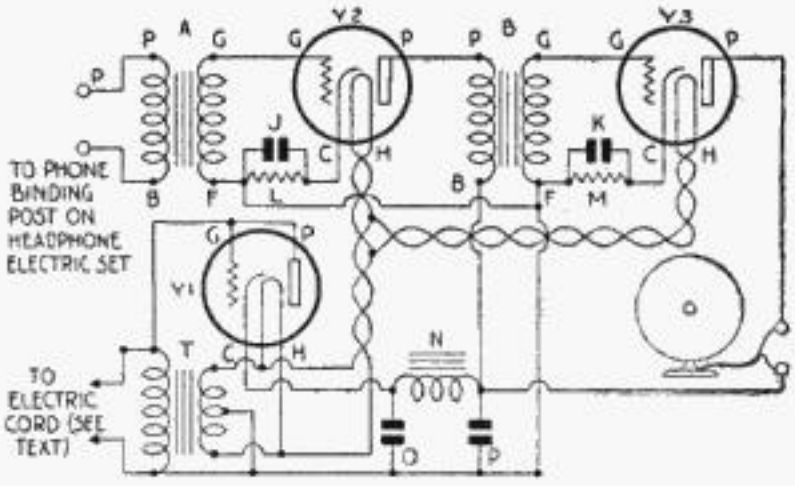
ALL tube manufacturers pack with each tube an instruction sheet giving the electrical specifications of the tube, such as recommended plate voltage, grid bias, plate current, and so on.

With these figures at hand, the experimenter should find it easy to calculate the value of the biasing resistance that will produce the proper grid bias voltage. Just multiply the specified bias voltage as obtained from the instruction sheet by 1,000 and divide this figure by the plate current in milliamperes as given on the instruction sheet. The result will be the required value of biasing resistance in ohms. When more than one tube is biased by the same resistor, as in push pull amplifier circuits, the value of the resistor in ohms should be divided by the number of tubes.

It is not necessary to make allowances for differences in plate voltages, as these are, to a large extent, self-compensating. In other words, if you intend to operate the tube at a somewhat lower plate voltage than specified on the instruction sheet, the lower plate current caused to flow in the tube by the lower plate voltage will automatically produce a correspondingly lower bias voltage.

Furthermore, it is not necessary to be too fussy about obtaining precisely the calculated resistance for the grid bias circuit. For example, if the calculation shows that, say, 1,750 ohms of resistance are required, any fixed resistance from 1,600 up to about 1,900 ohms will be near enough to serve the purpose.





At left, drawing shows the parts needed and manner of assembling them to fit your headphone set with a loudspeaker unit. Above, diagram giving wiring and connections for set illustrated at left

How *to* Fit *a* LOUDSPEAKER

to Your Headphone Set

By ALFRED P. LANE

YOU can build easily this new, simple audio amplifier unit designed especially for use with the Headphone Electric Set described some months ago (P. S. M., Apr. '31, p. 83) and also detailed in our Blueprint No. 130.

The Headphone Electric Set has proven immensely popular with our readers. Many who have built it have asked how to increase the volume so as to use a loudspeaker. They suggested adding a stage of audio amplification to the original circuit. This, however, is not practical. The simple B supply circuit of the Headphone Set will not supply the additional B current needed by an amplifier tube.

The solution, as here worked out, is to construct an entirely separate unit with its own B supply. Of course you must not expect to obtain from this simple unit the tremendous volume of which the modern full electric set is capable. It will give loudspeaker results comparable with those to be had from the older battery type radios before the days of the power tube. This volume level will meet the requirements of a surprisingly large number of radio listeners.

Those who have already built the Headphone Electric Set will find, on studying the theoretical and picture wiring diagrams, a decided similarity between the two units.

In each case a type 227 tube is used as a rectifier to furnish the B current and a small 2½-volt filament heating transformer supplies current to the two 227 tubes in the circuit as well as to the rectifier tube. Both units derive their B supply from the 110-volt house current, no step-up transformer being used.

The parts you need are shown in the accompanying table.

This unit can be built much more compactly than the Headphone Electric Set, as no panel is needed and there are no controls. Almost any arrangement of the apparatus can be used. It is well, however, to keep the two audio transformers A and B several inches from T and N.

A good layout is to place A and B close together with their cores at right angles at one side of the outfit with T and N in similar relation at the apposite side, with the tubes, filter condensers, and so on in between.

The output of the Headphone Electric Set is connected to the input of the audio circuit by wiring the binding posts of the amplifier to the headphone binding posts of the receiving set. Make sure that the binding post in the amplifier that is wired to the P terminal of the first audio transformer A is connected to the phone binding post that is wired to the choke O in the Headphone Electric Set.

WHAT YOU NEED TO ADD A LOUDSPEAKER

A and B—Standard audio-frequency transformers, any good make.

T—2½-volt filament heating transformer capable of handling at least three type 227 tubes.

N—Small 30-henry choke coil or primary winding of old audio transformer.

Y1, Y2 and Y3—Standard five-hole Y type sockets.

J and K—One-microfarad bypass condensers.

L and M—Fixed resistances, 1,500 ohms each.

O and P—Two-microfarad filter condensers, 200 volts rating; if hum is troublesome, use a tubular 8-microfarad electrolytic at each point.

Of course it is entirely practical to install a double circuit jack at the right end of the Headphone Electric Set panel and make connection to the amplifier in this way so that when desired the headphones can be used and the audio amplifier cut out. In this arrangement, the wires shown connected to the phone binding posts of the receiver should be connected to the outer prongs of the jack and the wires from the amplifier input to the inner prongs.

The method of supplying 110-volt current to the amplifier unit will depend on whether the amplifier is to be used at all times or whether it is to be cut out occasionally while headphones are used.

In the first case, the cord from the amplifier unit can be spliced into the cord from the Headphone Electric Set. Note that one side of the line in each case goes to the plate and grid connections of the rectifier tube in socket Y1. Make sure that these two wires are connected together. If you wish to be able to cut off the amplifier unit separately, put a cord switch in the cord from the amplifier.

The proper type of loudspeaker to use with such an outfit is, of course, a magnetic cone or other speaker of the kind sold for use with battery sets.

This amplifier unit can be used with any simple one or two tube receiving set, battery operated or otherwise, but is especially designed to work with Headphone Electric Set of Blueprint No. 130. The latter set was not originally designed for additional audio amplification and its filter circuit is therefore of the simplest type. However, if you find too much hum coming from the combination, use larger filter condensers at O and P as already mentioned, and, if this does not remedy the trouble, substitute an eight-microfarad electrolytic condenser at M in the Headphone Electric Set.

In many cases it will be found that a noticeable hum can be eliminated by reversing the plug in the wall socket.

Equipping Short Wave Set with

PLUG-IN COILS

TUBE BASE COILS

WAVE LENGTH RANGE	GRID COIL B *(.00014 mfd. condenser)*	TICKLER COIL C *(Spaced ½" from B)*
15 to 40 meters	3 turns No. 18 wire	4 turns No. 28 wire
30 to 90 meters	8 turns No. 18 wire	10 turns No. 28 wire
80 to 250 meters	24 turns No. 22 wire	15 turns No. 28 wire
240 to 550 meters	80 turns No. 28 wire	15 turns No. 28 wire

THE business end of a radio receiving circuit, the part that catches the air waves and turns them into something that will operate a loudspeaker, always consists of a coil of wire, a variable condenser, and a radio vacuum tube. This holds good whether the set is a simple one-tube receiver or the latest and most elaborate superheterodyne job.

In the early days of radio, when the whole subject was shrouded in mystery even to the engineers, some weird and wonderful effects were produced in the way of both tuning coils and condensers. Coils in particular went through remarkable evolutions.

Many types of basket weave, figure-eight, honeycomb, and other complicated styles of winding were tried.

Increased radio knowledge has shown, however, that the plain, single-layered coil gives the best results. The single exception is the honeycomb or its improved form, the duolateral. This type has many advantages for tuning the long waves or low frequencies where many turned inductances are required.

With the renewed interest in short wave, high-frequency reception, experimenters are again turning to plug-in coils.

The plug-in coil is not a distinct type of winding. It is any coil so made that it can be removed quickly from the circuit without changing any connections. The object of the construction is, of course, to permit changing coils so as to extend the range of wave lengths or frequencies that may be tuned.

At present the demand for plug-in coils is for short wave receivers of the simpler type using a single tube or two tubes in the radio-frequency end of the set. The development of the superheterodyne suggests the possibility of all wave types of receivers using plug-in coils because this is practical with the superheterodyne, however difficult it may be with the multi-stage radio-frequency tuned circuit.

Building a special type of mounting for plug-in coils is a bit too difficult for the average radio experimenter. Fortunately this is not necessary. A vacuum tube socket and the bases from burned-out radio tubes make a perfect plug-in system.

Fig. 1. A paper cylinder, permanently cemented on one base, provides more space for winding the coil

ONE way to do the job is to wind the coils directly on the bases, but a better method, worked out by C. W. Brockett, Jr., Utica, N. Y., a reader of POPULAR SCIENCE MONTHLY, is shown in Fig. 2. Instead of winding the wire directly on the base, a form is prepared by placing two bases end to end and a wide strip of paper is wound in a smooth cylinder. The end of the paper is cemented, and after the cement has dried, one of the tube bases is withdrawn and the paper cylinder is permanently cemented in place on the other. It can then be dipped in molten paraffin or treated with a couple of coats of lacquer.

The advantage of this construction is that it provided more space for the winding.

Assuming that you have a .00014 mfd. condenser for tuning, the approximate winding specifications to cover all waves from fifteen to 550 meters are given in the table in the box above. Coil *B* in this table is the grid coil and coil *C* is the tickler.

For those who are not familiar with the standard single-tube hook-up, we suggest that our Blueprint No. 103 shows this circuit and will work perfectly with plug-in coils on tube bases wound approximately as specified. Connections to coils *B* and *C* by means of the prongs on the base should be made exactly like the connections to the similarly lettered coils shown in the blueprint.

Fig. 2. A good method: Two old tube bases are placed end to end and a strip of paper wound on them. The end of the paper is cemented

NOTE that no antenna coil is specified in the table (coil *A* in Blueprint 103). On the shorter waves none is required, as a connection from the antenna directly to the grid end of the coil by way of a condenser of extremely small capacity provides sufficient coupling.

A suitable condenser can be made by clamping two half-inch-wide brass right angle brackets to a piece of bakelite so that the upright portions face each other one eighth of an inch apart. The required capacity is that of half inch square plates that distance apart.

On the longer short waves just below the broadcast band, and on the broadcast band itself, an antenna coil is needed. The use of five-prong tube bases from old 224's or 227's will provide the extra connection for the antenna coil, as one end of the latter is wired to one end of coil *B* and therefore shares a prong with it.

On the shorter waves, slight differences in the arrangement of the wiring and the resultant differences in capacity introduce tuning errors.

If you find that the coils as wound do not cover the wave bands desired, and the error is substantial, the cure, of course, is to change the number of turns. Slight adjustments can be made by spreading the turns a bit.

SO MANY readers have requested more articles on getting started in amateur radio that John Carr will continue with the series. The first appeared last month (P. S. M., Jan. '32, p. 69). The next will appear in the March number.—The Editor.

GUS *tells* How to Save Gas

By MARTIN BUNN

"The advantage about this kind of a record," Gus said, "is that it's a fine check on your car's condition"

"WHEN I got here," Jack Norcross boasted, "the speedometer showed just 208 miles for the trip. Then I had the tank filled again right up to the brim and ten gallons was all we could get in it. Figure it out for yourself! Comes out mighty close to twenty-one miles to the gallon. That's what I call getting mileage out of gas, eh, Gus?"

"Maybe so," grunted Gus Wilson, veteran auto mechanic and half owner of the Model Garage, "but all you've proved is that you've driven here from Whippville, today, on ten gallons of gas—more or less!"

"More or less!" echoed Norcross angrily. "Didn't I just tell you we started with a tank full and we could only get ten gallons in when we got here? If that isn't ten gallons for two hundred and eight miles then what is it?"

"No sense in flying off the handle, Jack," said Gus. "What you say sounds fine till you stop to think a bit. For instance, are you sure the car was setting at exactly the same angle when the tank was filled each time? With the filler opening at one end it only takes a bit of a slant one way or the other to make a gallon or two difference.

"Another thing, Whippville is way up in the mountains and there's a powerful lot of long easy downgrades coming this way. On top of that, you've had a rip-snorting tail wind boosting you along for the whole trip. Considering all those things, the mileage you got today may be interesting, but it doesn't tell you much about the gas mileage you can get out of your car."

Young Norcross snorted disgustedly. "Well, how in blazes do you get a real test if you've got to figure on wind, the number of hills, and so on?" he demanded. "Must be as bad as those brain-wreckers the mathematics teacher used to shoot at us every so often."

"It sure would be," said Gus, " if you tried to figure the effect of all those things. But you don't have to. Make the effect of the wind and hills zero by doing a round trip test. Then, if you are mighty careful to see that the car is level both times when you fill the tank, the test will mean something, especially if you try it several times and then take an average.

"Anyhow," he continued, "there are two ways to find your gas mileage. One is to make a special test. The most accurate way to do that is to fit a small special tank that holds exactly a gallon or a half gallon, or to do it as Mr. Boltan does.

"Show Jack your gas record, Mr. Boltan," said Gus, turning to an elderly, dignified chap who had joined the group.

BOLTAN flipped a tiny notebook out of his upper coat pocket with an easy motion that denoted much practice.

"Here it is," he smiled. "Quite simple, too. I just put down in this column opposite the date the speedometer reading every time I get gas and over here I put down the number of gallons. I've kept this record ever since I bought the car. I can tell you exactly how many miles I averaged to the gallon for the first two thousand miles, the last two thousand, or for all the miles I've driven the car just by dividing the miles over any period by the number of gallons I've bought."

"THE point is, Jack," Gus cut in, "what counts, as Joe and I always tell our customers, is not how many miles you can get out of one particular gallon over one particular route, but how many miles do you average on a gallon of gas? Of course, gasoline is cheap now, but there's no telling when it'll go up again, and with every state charging a gas tax running all the way up to seven cents a gallon in Florida, gas mileage may soon be an important item.

"Another advantage about that kind of a record," Gus added, "is that it's a fine check on the condition of your car. Every so often you can figure the mileage for the last thousand miles and see how it compares with previous records. Any falling off in mileage is a pretty good sign that the motor needs tending to."

"I can see where a record like that gives the real dope," Norcross agreed after he had carefully examined Boltan's neat rows of figures. "I think I'll start one."

"If you do, Jack," Gus grinned, "you'll have to watch your step if you want to come anywhere near equaling Mr. Boltan's record."

"What do you mean, watch my step?" asked Norcross. "Of course you've been driving lots longer than I have," he told Boltan, "but I'll bet you I can come as near getting all the miles there are in a gallon of gas as you can."

Boltan slipped the notebook back in his pocket. "Gus is just kidding you, Jack," he smiled. *(Continued on page 135)*

GUS says:

There are two ways to look at this skidding proposition—one is to hope you won't and the other is to see that you don't. Rubber tires have good traction on dry highways. They hold well, too, on reasonably clean wet concrete; but ice on any kind of road surface just naturally kills the grip of the rubber. Steel tire chains may be noisy, but they make icy driving reasonably safe.

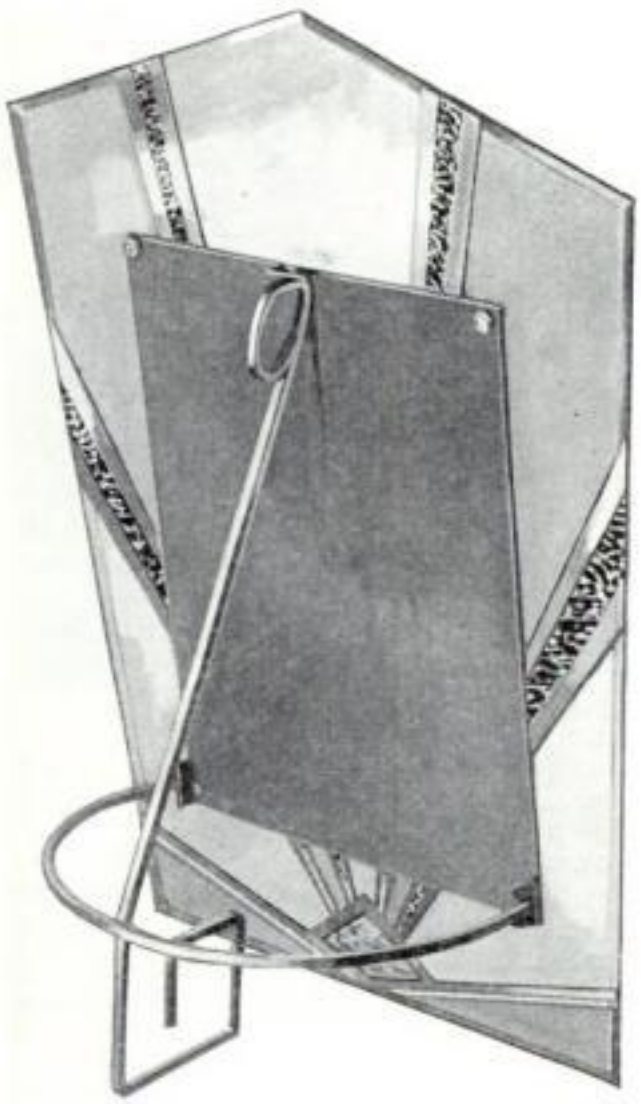
Modernistic Picture Frames

Made from Broken Mirrors and Plate Glass

By FRANK L. FISH

MODERNISTIC picture frames combining cut glass, clear glass, silvered glass, frosted glass, and polished brass form an attractive setting for one's favorite portrait photograph, print, or etching. Although the retail price of these novel new frames in many smart gift shops is from ten to twenty dollars apiece, they can be constructed at home for a very small sum. A fragment of a large mirror was used for the first frame to be described, and a piece of broken automobile windshield, purchased at a junk yard for ten cents, was used for the second.

This new type of novelty picture frame costs little to make but is quite expensive to buy



A back view showing the strips of crinkled tin foil, the brass plate, and the wire stand

The first step in constructing the mirror type frame is to make a full size pattern of the design as shown in the drawings on the following page. Of course, the dimensions may be altered to fit any picture. After making the paper pattern, trace the design on the painted or silvered side of the mirror by means of carbon paper and a hard pencil. Practically all the work is done on the back.

First cut out the frame with a good glass cutter and a metal rule. Use a firm, steady pressure to make a clean sharp cut. Place a wooden block under the cut at one end, as suggested in one of the drawings. Then grasp the edges of the glass firmly, and bend downward. In this manner break each edge in turn.

The next step, grinding and beveling the edges, requires only a common gray whetstone or sandstone and plenty of water.

Remove the silver coating from the picture space in the center of the frame and from all sections that are not to remain mirrorlike (see the upper photograph on page 76). For this work use a small penknife and the metal rule. Place the rule over the portion to remain untouched, hold it firmly in position, and scrape the silver along and away from the edges of the rule.

On the lines which define the outlines of the frosted sections, use the glass cutter and the rule to make cuts in the back of the glass, thus outlining the parts to be frosted. Widen and smooth these lines with the point of a small three-cornered file. To grind the frosted sections, indicated by the areas of darker gray in the design drawing, use a small gray whetstone, No. 80 emery dust, and water. Wet the glass liberally, sprinkle the emery dust lightly over the surface, grind with the whetstone, and add water as it is needed. If a firm, even pressure is used in grinding, the result will be a smoothly frosted finish.

The dark sections in the drawing are strips of bright, finely crinkled tin foil. If preferred, these sections may be black enamel instead of tin foil. Cut the crinkled tin foil in strips slightly wider than the clear glass they are to cover and attach the edges to the back with shellac.

LAY the frame on a perfectly flat surface and drill the four 3/32-in. holes with a steel twist drill. Be sure to keep the drill running in fresh thin lubricating oil or in a mixture of turpentine and camphor.

For the backplate, obtain a sheet of No. 24 gage brass at least 7 by 8⅜ in. Cut this to 6 by 8 in. with three projecting lugs, as shown. Drill and shape the ⅛ in. square holes in the lugs; then drill the four 3/32-in. holes in the plate to coincide with those already in the glass.

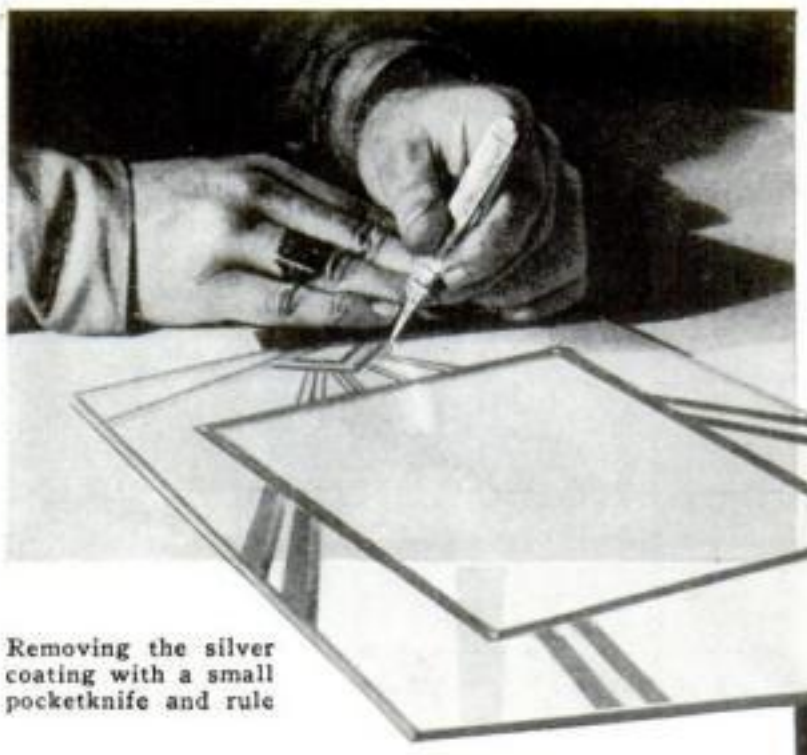
The two-piece modernistic support for the back is bent from ⅛ in. square brass rod. The half-circle horizontal brace has a 3⅛-in. radius, and the upright back

strut is shaped as illustrated. These two pieces are soldered as in the drawing. In each rod end, where it enters the back plate, is filed a small groove which locks the rods firmly in place. This construction permits the support to be removed instantly by a slight pressure on the sides of the ring. If desired, the heads of the small brass bolts that fasten the back to the glass may be ground flat and square.

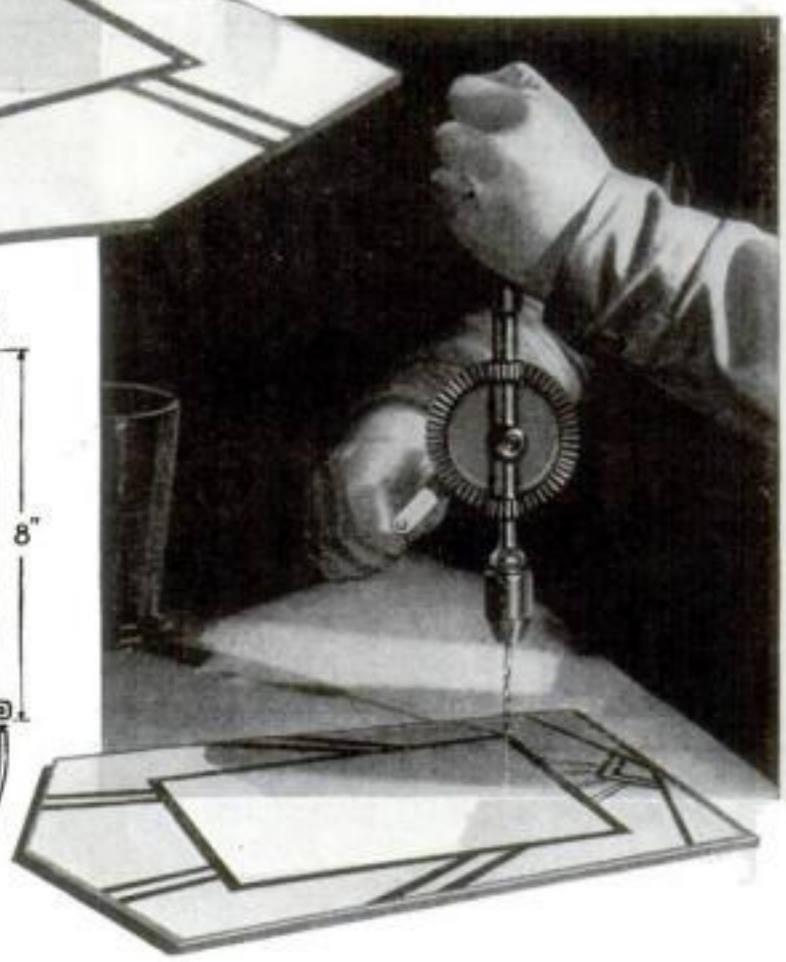
Trim the selected photograph or print to the size of the backplate, fasten both print and plate to the frame, and lock the support in place by means of the small notches.

A second frame was made from a piece of plain glass in exactly the same way except that smooth tin foil was fastened to the back of the glass to substitute for the silvered parts of the mirror. The foil was held in place with gelatin size, but if this is not available, any thin, transparent cement or glue will do just as well.

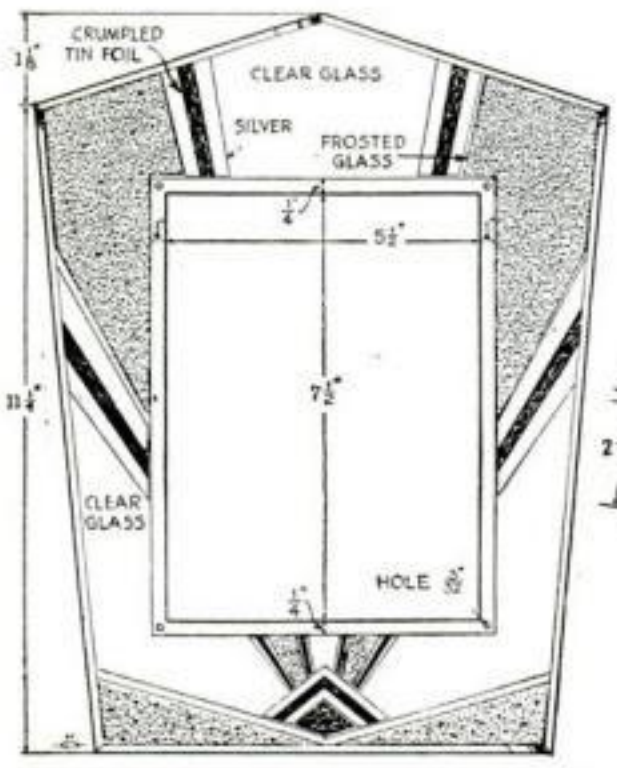
The same general methods will enable the ambitious home craftsman to work out his own original ideas in glass, brass, and chromium plate.



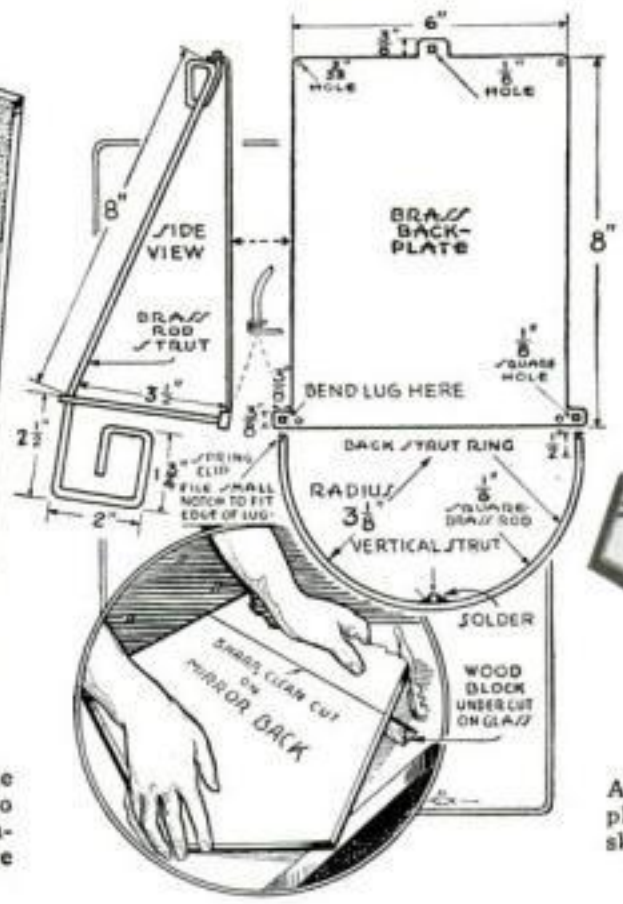
Removing the silver coating with a small pocketknife and rule



A twist drill is used for making the holes in the four corners of the central rectangle



How to lay out the paper pattern for the design. The gray areas are the portions to be frosted, and the darker strips are crinkled tin foil. Compare with photograph above



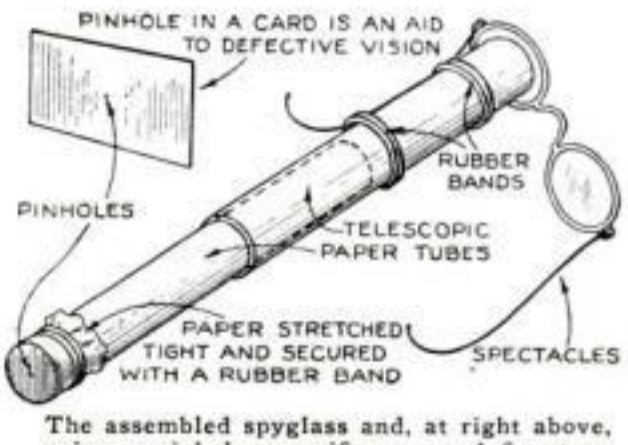
At left are drawings of the back plate and supporting struts, and a sketch showing how to cut the glass

CURIOUS SPYGLASS HAS PINHOLE EYEPIECE

MOST of us are familiar with the pinhole camera, but the pinhole spyglass is something new. To make one, borrow the spectacles of a farsighted person or buy a cheap pair at a ten-cent store. This type of lens magnifies, and when used as a burning glass in sunlight, a bright spot of light is focused at a distance from the lens known as the "focal length." A lens of 20-in. focal length gives excellent results. Roll a piece of paper into a tube about two thirds as long as the focal length and slip a rubber band about the middle. Stretch a piece of paper over one end of the tube and hold it in position with another rubber band. With an ordinary pin make a tiny hole in the center of this paper cap. Use the extreme point of the pin so that the hole will not be more than half of the diameter of the main body of the pin. With a third rubber band fasten the spectacle lens over the other end of the tube as shown. If an unmounted lens is used, it may be laid over the end of the tube and held by paper and a rubber band. No focusing is necessary.

Use the device as an ordinary spyglass, keeping the eye close to the pinhole. The length may be changed to vary the magnification by using two tubes, one slipping easily within the other. If the drumhead cap is made of black paper and the pinhole centered snugly in contact with the optical system of a camera, a surprisingly good telephotograph may be taken. Use several seconds' exposure and guard against any motion of the parts.

Pinhole vision is as interesting as it is curious. No matter how seriously an eye may be afflicted with near-sight or far-sight, with or without astigmatism, vision becomes perfect for an object at any distance when viewed (with or without spectacles) through a small pinhole held close to the eye. Try watching a movie screen through a pinhole made in the ticket stub. Looked at through a tiny hole punched in a piece of paper torn out of the margin of a page, the print of a telephone directory is easily read by a defective eye, if the book is well lighted and the hole placed as close as possible to the eye.—L. PYLE.



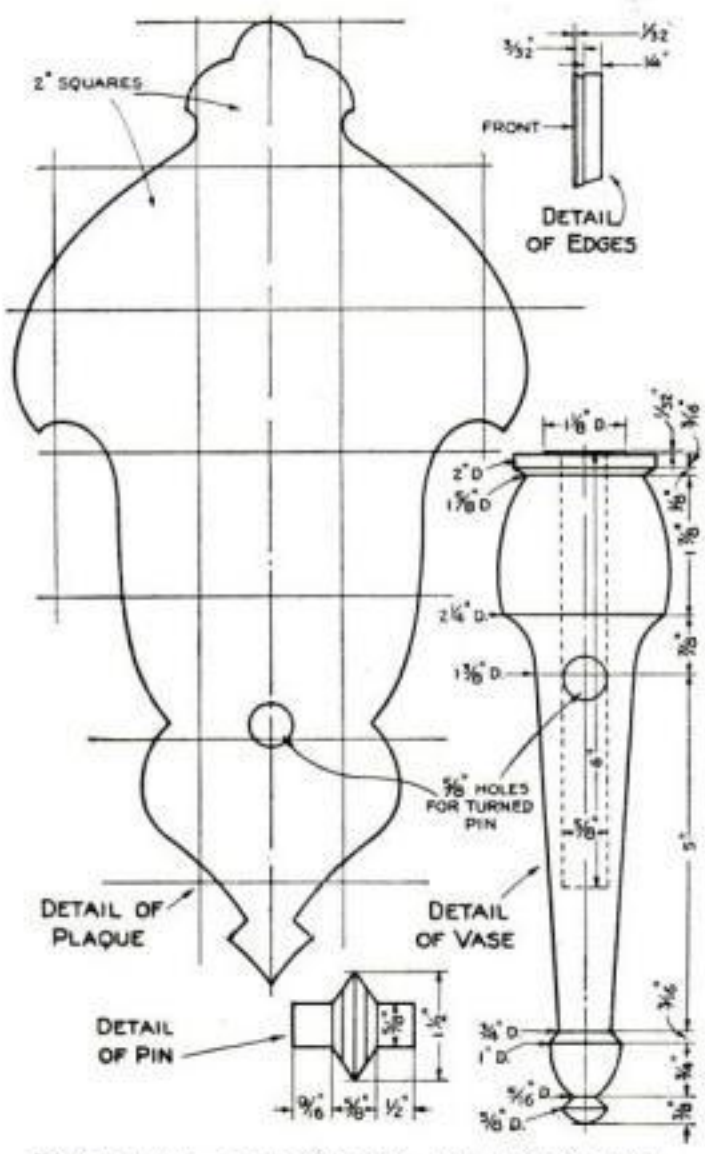
The assembled spyglass and, at right above, using a pinhole magnifier to read fine type

WALL VASE FOR FLOWERS

This ornamental flower holder designed to hang on the wall is made entirely of walnut except for a small test tube set in the vase

In the belief that there might be commercial possibilities in an attractive wall plaque vase of walnut he had made for his home, an amateur woodworker placed two or three samples in one of the department stores in the moderate sized city in which he lives. Within three weeks he received seven orders for duplicates and two special orders for more elaborate pieces. The plaque was cut on a jig saw from a piece of finely figured walnut ⅜ by 7⅛ by 14 in. The edges could be left plain or slightly rounded, although the original model was given a very delicate ornamental groove as indicated in the drawings. This was cut with a small routing tool which had been made for the purpose. The tool was mounted in the lathe chuck, and a temporary plate was set up so that the groove could be run around the edges in a few seconds. The piece was then filled, sanded, stained, and given two coats of clear lacquer. The polishing was done by setting a cloth-covered spindle between the lathe centers and sliding the piece lightly back and forth over it. Finally a ⅝-in. hole was bored through the center 3⅝ in. from the bottom to receive the pin which supports the vase, and another small hole 1 in. below the top for hanging the plaque. The vase was made from an old stair baluster. First a ⅝-in. hole was bored 6 in. deep. Then a small plug was turned and tapped snugly into the opening so that the piece could be mounted between centers to be turned. The finishing and polishing were done in the lathe. The connecting pin was next made as shown from a bit of scrap walnut and finished in the same way; then the three parts were assembled with high-grade liquid glue. The simplest method of adapting a vase of this kind for flowers is to slip a test tube into the hole. Another plan is to fill the hole with melted paraffin and pour out the surplus, leaving a heavy waterproof coating of wax. Articles of this kind, because they are out of the ordinary and have a handmade look, are more highly appreciated than factory products and, of course, they make far more personal gifts.—Dale R. Van Horn.

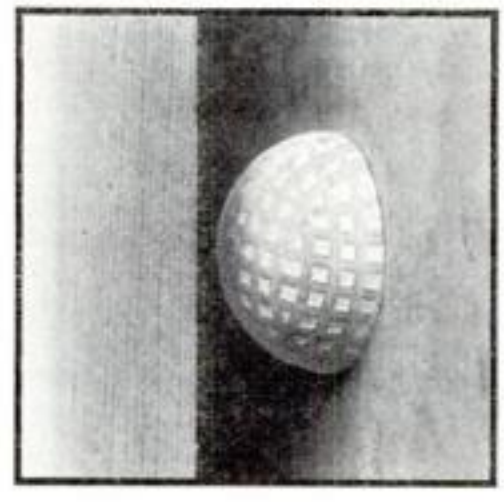
The plug used in the central hole while the vase part is being turned and finished



Plaque, vase, connecting pin, and molded edges

NEAT RUBBER DOOR BUMPERS

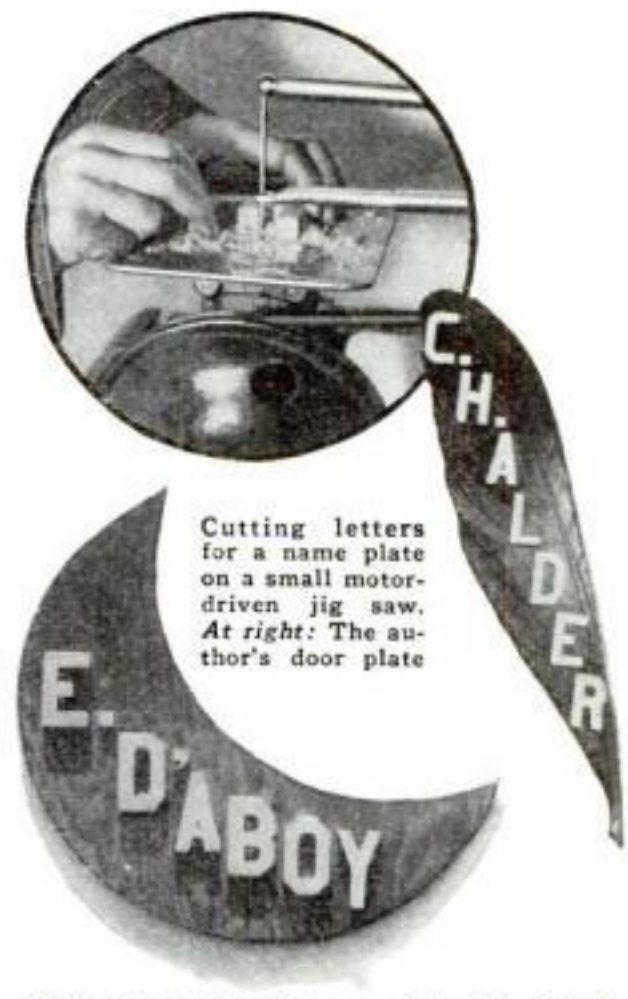
Bumpers and stops made for larger doors and swinging windows cannot be used satisfactorily with many smaller doors, lids, and covers of various types, yet often something bigger or more efficient than a rubber-headed tack is needed. For this purpose, obtain a soft rubber toy "golf" ball or other sponge rubber ball at a ten-cent store and cut it squarely in two with an old razor blade, following the center or mold line. With a single nail fasten the half ball where it will take the impact, and sink the head of the nail well below the surface of the rubber.—F. W. B., Jr.



JIG-SAWED NAME PLATE TELLS OWNER'S HOBBY

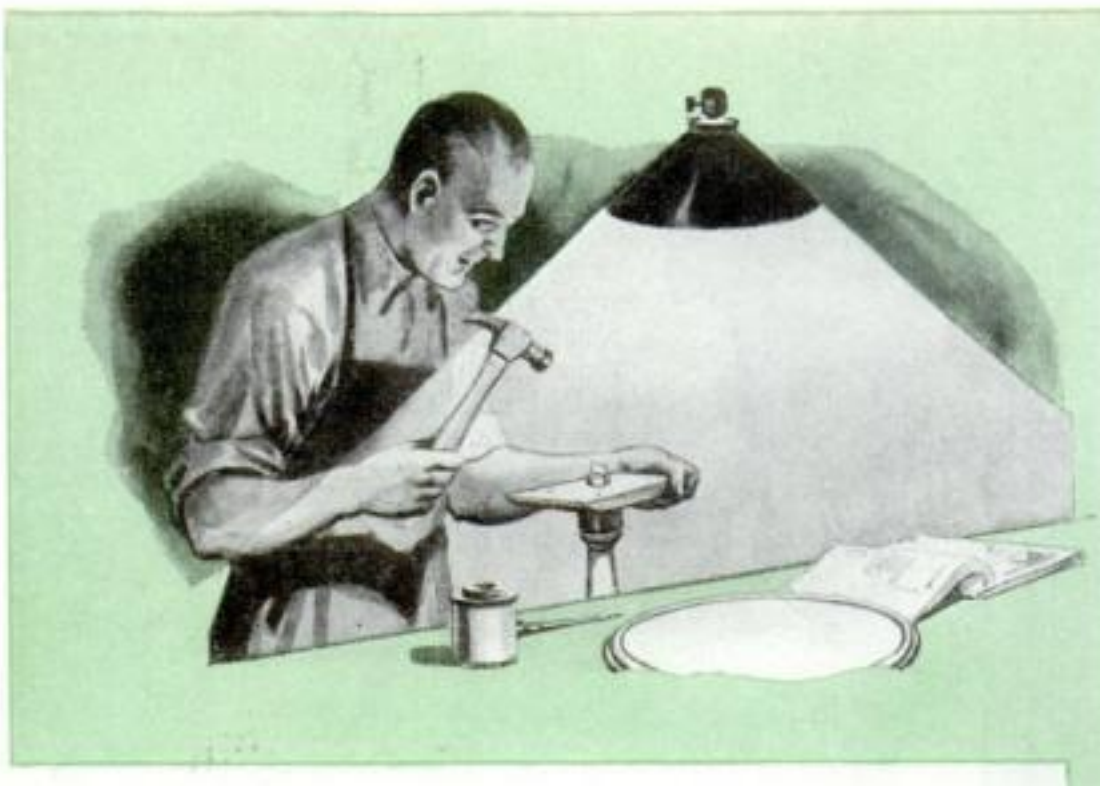
With a little ingenuity, any home worker can make an appropriate and expressive name plate for himself in either wood or metal. The important thing is to choose a suitable symbol and style of lettering, and a pleasing color scheme if colors are to be used. Where the name plate is to be used also must be considered. Those illustrated are merely suggestive. One was made by the writer for his own use and the other for a friend who makes a hobby of astronomy. Both were cut from wood on a small motor-driven jig saw. The feather used as the background for one of the names is lacquered brilliantly in a variety of colors, but the quill end is black, as if dipped in ink. The letters, which were cut out individually and fastened in place with waterproof (casein) glue, are gilded. The other name plate consists of gilded letters on a plywood crescent.—Charles H. Alder.

Decorative front door name plate



Cutting letters for a name plate on a small motor-driven jig saw. *At right:* The author's door plate

This crescent-shaped name plate with gilded letters was made for an amateur astronomer



ANYONE CAN ASSEMBLE THIS BEAUTIFUL

Solid Mahogany *Tray-Top Table*

This table has that indefinable look of quality found only in the most expensive furniture. It is strong, too. The block on which the top rests is fastened to the column with the glued and wedged joint shown in the drawing at the left

By Making Use of Our Remarkable New, Low-Priced Furniture Kit, Which Comes All Ready to Set Up

A READY-TO-ASSEMBLE kit of parts for constructing a rarely beautiful, solid mahogany tray-top table is offered by our new service organization, the Popular Science Homecraft Guild, as its second contribution towards helping readers to build furniture of the finest quality at the lowest cost.

All the parts are perfectly machined from the best grade of Honduras mahogany—the mahogany of mahoganies. Together with the necessary screws, dowels, and special finishing materials, they will be sent to any reader in the United States for $5.90. This price includes the shipping charges. In ordering please use the coupon on page 118. Note that the kit will be sent C. O. D. for this price, or you may send cash with your order.

This is no ordinary offer. The design is exceptional because it is the carefully studied work of a man who is one of the world's greatest experts on high-grade, custom-built furniture. The wood is unusual because the average home craftsman cannot obtain mahogany of equal quality from his local lumber dealer, no matter what he is willing to pay. The machining of the parts is of the most exact and workmanlike character because it has been done in one of the leading furniture factories, where only the best grade of furniture is made. The finishing materials, too, are of a type you can obtain nowhere else, since they were developed especially for this one purpose and represent a new, simplified three-step process by which an amateur can rival the work of professional furniture finishers.

The table itself is an historically accurate adaptation of a design which dates from about 1780. The top is 15 in. in diameter; the height, 23 in. The delicacy and grace of the parts—particularly the molded edge of the top, the turned post, and the Dutch style legs—are evident from the most casual study of the accompanying photographs. And the table is as useful as it is beautiful. It can be used equally well in a living room or a bedroom, and is ideal for holding a lamp, a piece of pottery, a flower vase, or books and smoking accessories.

What little handwork is required consists mainly of rounding the legs. The few essential tools are mentioned as need for them arises in the following instructions. You will also require a few sheets of Nos. 1 and 00 sandpaper, a package of No. 000 steel wool; a little cold water (casein) glue, cabinetmaker's hot or hide glue, or high-grade liquid glue, as preferred; and two or three 1½-in. fine bristle paintbrushes for applying the finishing materials.

The parts of the tray-top table, as you will receive them, consist of the following, which are illustrated in the photograph on page 79:

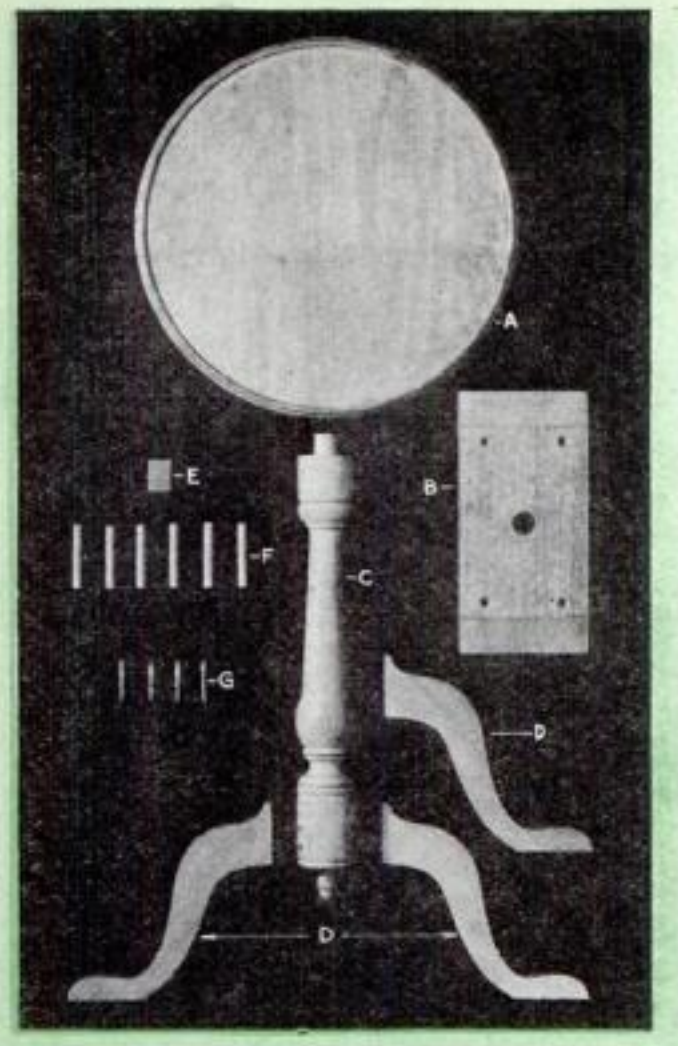
1 circular top *A*, 15 in. in diameter.
1 block or top plinth *B*, 5 by 10½.
1 turned central column or post *C*.
3 legs *D*, shaped and bored for dowels.

1 block *E*, ¼ by ⅞ by 1⅛ in. for making a wedge or spline.
6 dowels *F*.
4 screws *G*.

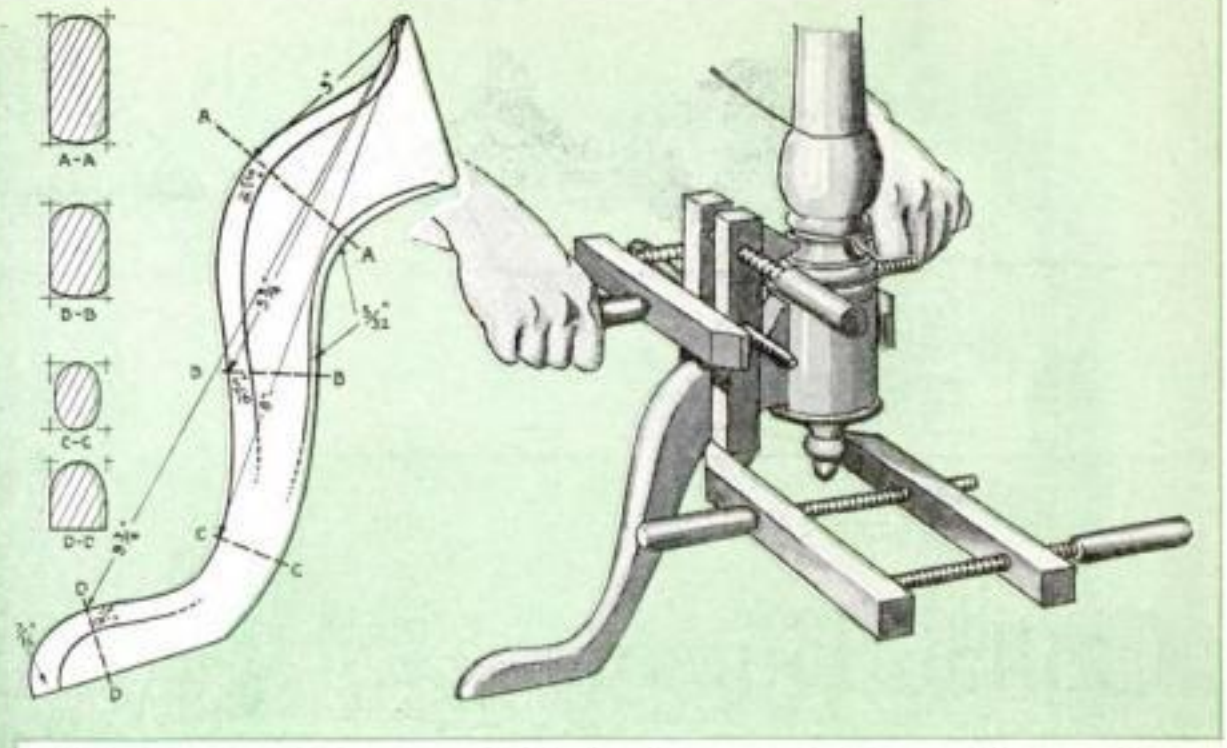
In addition to these parts, each kit contains the special Popular Science Homecraft Guild process finishing materials in three cans and cheesecloth for making pads. One can contains the combined stain and filler; the second, the seal coat; and the third, the gloss coat.

The first operation when you receive the kit is to round off the three legs *D* with a fine cabinet rasp or a half-round file. In order to do this, mark each leg, on both sides, with pencil guide lines approximately as shown on the drawing at the top of page 79. The rounding should be up to the line except at the narrowest part of the leg marked *C-C*, where the leg becomes oval in shape. Note that the front of the leg is rounded more than the back. Compare your work

Designed and Guaranteed by



These are the parts as you will receive them. In addition, the kit contains three cans of special finishes—a combination stain and filler, a seal coat, and a gloss coat—and cheesecloth for pads



The edges of each leg are rounded back as far as the inside curved lines in the drawing above. The shape is also shown in the cross sectional views *A-A*, *B-B*, *C-C*, and *D-D*. At the right is a sketch to show the method of clamping the leg joints

with the cross sections given at *A-A*, *B-B*, *C-C*, and *D-D*. When the legs are properly shaped, sandpaper them to a smooth surface. This will soften the guide lines (which were first marked with pencil) so they will show only faintly as a rounded corner.

Next take the top plinth *B* and with the curved side of a small rasp or, better, a rat-tail file, slightly enlarge the large central hole from what is to be the top side (that is, the side opposite the one where the screw holes are countersunk). This enlarging should be slight—only enough to allow the dowel-like projection at the top of the leg column to spread a little when the wedge or spline is driven into it. Next make a saw cut, using a fine saw (preferably a backsaw), into this projecting column dowel at its center and running straight from top to bottom—that is, to the beginning of the post proper. Do not cut into the main part of the post. Then make the wedge, which should be 7/8 in. wide and 1 1/8 in. long and tapering in thickness from 1/16 to 3/16 in.

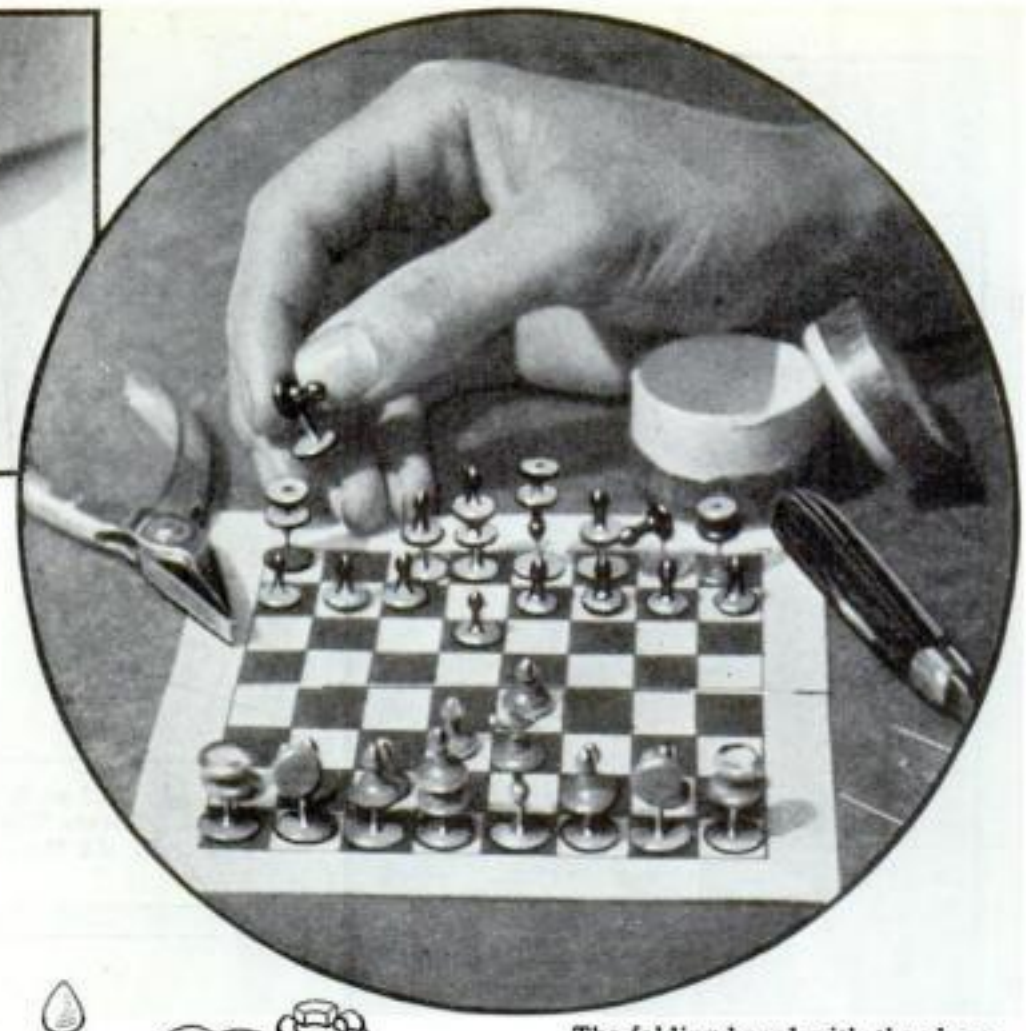
As the first step in the assembly, make a trial fitting of the three legs. Be certain that the dowels are a smooth sliding fit in the holes and not too long. Also try the column dowel into the hole in the top plinth. See that the spline is no wider than the dowel.

With this done, the leg column and the plinth can be glued together. Apply the glue to both hole and dowel, also to the shoulder on the column against which the top plinth *B* is to rest. After pushing the dowel into place, brush glue on the wedge and drive it into the saw cut in the column dowel. See that shoulder on the post and the plinth make good close contact.

As it is possible to glue only one leg to the column at one time, do one right away, but be careful not to jar *(Continued on page 118)*

Traveling need not interrupt your chess playing if you have one of these midget chess sets. The pieces fit in a thumb-tack box

Collar Buttons *used as* CHESSMEN



The folding board with the chessmen placed. *Left:* Sketches showing how the pieces are assembled

THIS tiny chess set can be made in a few hours' time from a handful of wooden collar buttons, a few thumb tacks and straight pins, a little black paint, and a piece of cardboard.

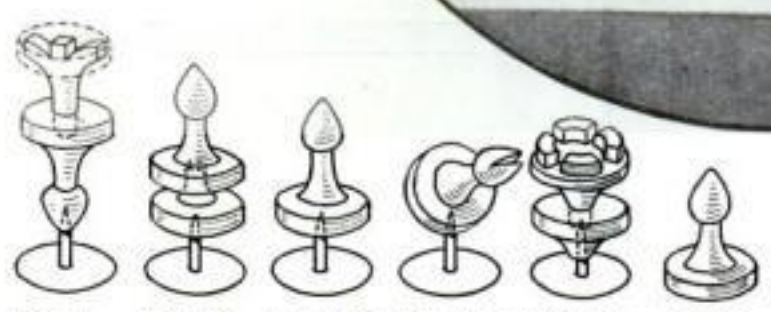
When complete, the men will fit in the thumb-tack box, and the chessboard will slip into a vest pocket. The portable set is especially convenient for traveling or for a game at a friend's house.

For the pedestals of the pieces in the king row use 7/16-in. thumb tacks with solid heads. To create the queen, cut the knob off a collar button. With pliers break off 3/16 in. of the sharp end of a pin and insert the blunt end in the center of the base of another collar button, after making a suitable hole by using a thumb tack as an awl. Now squeeze the cut end of the first collar button on the pin, and insert a thumb tack in the exact center of the bottom piece.

To make the cross for the top of the king, slice a collar button lengthwise, trim off the knob and part of the "spread," cut a wide notch on each side of the center, and attach to the base of a second button with another pin point. Before inserting the thumb tack pedestal in the king's standard, run the sharp point of the collar button across a sheet of sandpaper or trim it off with a knife to make a flat surface on the end. This will allow the tack to go in without splitting his royal highness lengthwise.

The mouth of the knight (or the horse which represents the knight) is formed by placing the knife blade a little to one side of the point of the button and cutting toward the center to prevent splitting. Pry the mouth open slightly.

In fashioning the top of the castle or rook, make a square-edged cup in the flat surface of a collar button by twisting a small screw driver blade around like a drill. If necessary, start the tool in the right track by grooving the center of the button with a knife. Then nick four small notches on the rim of the cup thus formed and remove the bevel by making the edges of the battlements perpendicular as shown. Cut the knob off this button and off another plain button and assemble the two with pins. For the bishop simply hoist a complete button on a thumb tack.

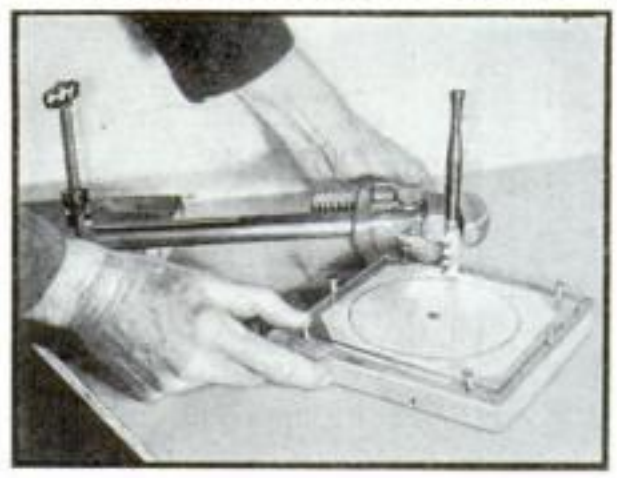


Make two queens, two kings, four knights, four bishops, and four castles, and save sixteen plain collar buttons for pawns. Dip one half of the midget men in black enamel or paint. Sometimes laundries use black wooden collar buttons as well as white. If black ones are obtainable, only the black king's cross and the tops of the castles need be dipped —those parts from which the black surface has been whittled away.

Lay out eight 1/2-in. squares each way on a piece of cardboard 5 in. square, leaving a 1/2-in. margin. Rule the lines in ink or with a hard colored pencil and darken the alternate spaces. Then cut the board in halves and hinge it on the back with gummed tape or labels, leaving a small crack so that it will fold flat. The board should be cut so the division comes between the players when the white corner squares are at each player's right. If desired, a more durable board can be made by covering the entire back with cloth.—HARRY E. WOOD, JR.

BY ADDING potassium oxalate crystals to water to form a concentrated solution, an excellent fluid can be made for indicating revisions or additions on blueprints. It may be applied with an ordinary pen or drawing instrument, and its bright color quickly attracts the eye. The solution is prepared by adding the crystals to the water bit by bit until no more will dissolve. Add scarlet drawing ink to get the desired color.—ARCHIE RIEDMEYER.

GLASS DISKS CUT WITH SIMPLE TOOLS

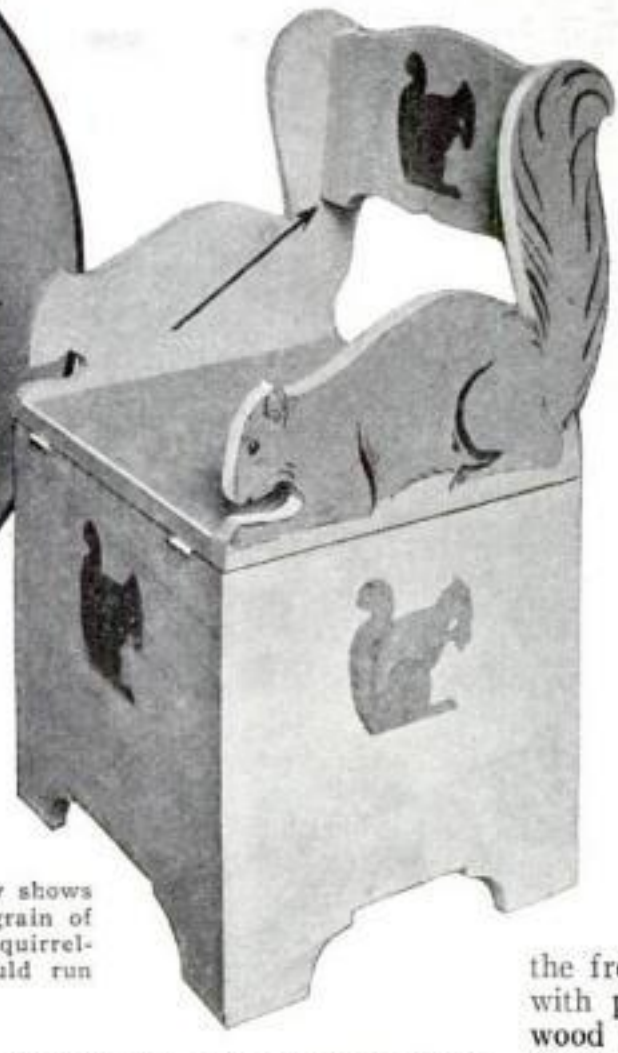


The wrench is clamped so that the wheel of the cutter is directly over the pencil line

CIRCULAR pieces of glass may be accurately cut without special equipment by the simple method illustrated. The size of the circle is marked on a sheet of white paper, which is attached to a block of wood with a long flat-headed screw passing through the exact center. The block of wood is then screwed to the workbench or other flat surface, the screw being left loose enough so the block will turn easily as if on a central pivot. The sheet of glass to be cut is next placed over the circle and fastened at the edges with small wood screws as shown. The glass cutter, which is usually round handled, is held tightly in the jaws of a pipe wrench, the handle of which is raised about 2 in. off the bench with wooden blocks and held securely in place with a large C-clamp. The drawn circle and the cutter wheel must be accurately aligned; then, while the cutter wheel is pressed firmly against the glass, the pivoted block is revolved once. The edges of the glass may be tapped off in the usual way. If desired, several additional straight cuts may be made at random from the circle to the edges of the glass to facilitate the removal of the waste. If more than one disk of the same size is desired, remove the glass without altering the set-up.—RAY J. MARRAN.

Child's Chair, Toy Box, and Play Table Combined in One Piece of Furniture

Children are never content to sit still very long, and with this unique play chair they don't have to

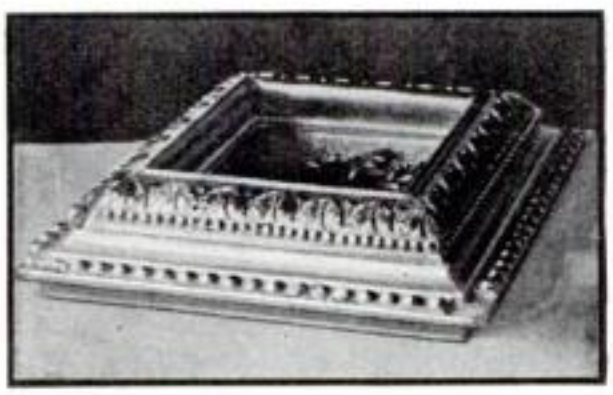


The arrow shows how the grain of the two squirrel-arms should run

RARELY does a child pick up and put away his toys without being prompted, but he is more likely to do it cheerfully if he has such an attractive and unusual hiding place for them as the bottom of this squirrel chair. It is a seat, toy box, and play table, all in one, and its decorations have the animal interest that always appeals to children. The box itself has a front and back ¾ by 13½ by 16 in., two ends ¾ by 13½ by 12½ in., and a bottom ¾ by 12½ by 14½ in. The parts were sawed 2½ in. up as shown to form the feet; then they were nailed together with eightpenny finishing nails. The bottom was nailed with its underside flush with the top of the feetlike projections.

The cover was made ¾ by 14 by 14¾ in. to give a slight projection over the ends after nailing on the arms. The latter were laid out with the end of the tail 13½ in. from the lower edge and band sawed from a board so the grain ran diagonally as suggested by the arrow in one of the photographs. They were then nailed to the ends of the seat or cover, which was hung with 1½-in. hinges. The back, ¾ by 7 by 14¾ in., was sawed and nailed between the tails of the squirrel arms. All exterior surfaces were given two coats of white paint; the outside of the squirrel arms were then painted a rather dark gray, and lines suggesting hair were drawn in with a pencil brush and black paint. Five squirrels 5 in. high were cut from gray pasteboard, made darker by a thin wash of black ink, and the hair lines were drawn with a coarse pen and ink. These were glued on the four sides of the box and on the front of the backpiece and were held with pins pushed in slantingly into the wood until the glue had time to become hard.—C. K.

CONCRETE floors subjected to continual moisture should not be painted but should be treated with a special concrete finish.

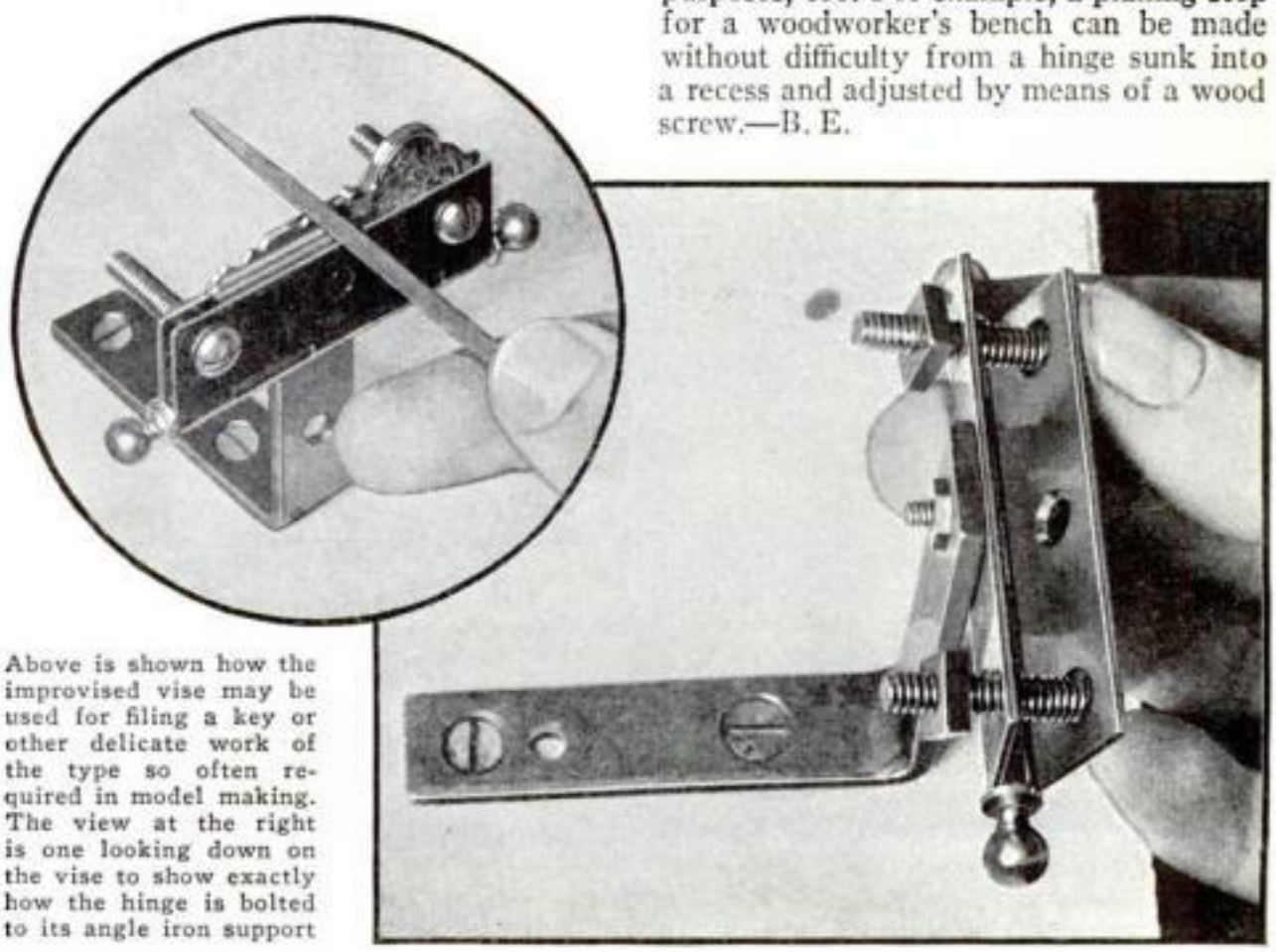


OLD PICTURE FRAMES MAKE FANCY TRAYS

FROM an old-fashioned gilt picture frame with wide moldings, such as were popular many years ago and are to be found in many attics, it is possible to make unusual and decorative little trays. The simplest form is a square shape, the pieces for which are cut from the molding in an accurate miter box and nailed together like a picture frame. Of course, the molding, no matter what its shape, must be cut so that the high side will form the outer rim of the tray. Other shapes may be made by using five, six, or more pieces, but the joints will have to be cut very accurately to the correct angles in an adjustable miter box or on a circular saw table. The completed tray may be left with the original finish or decorated in any way desired. Polychrome bronze powders, obtainable in numerous shades, give an attractive appearance. As the finishing touch, and to protect the surface on which the tray is to be placed, felt should be glued to the bottom.—PAUL HADLEY.

SMALL VISE IMPROVISED FROM HINGE

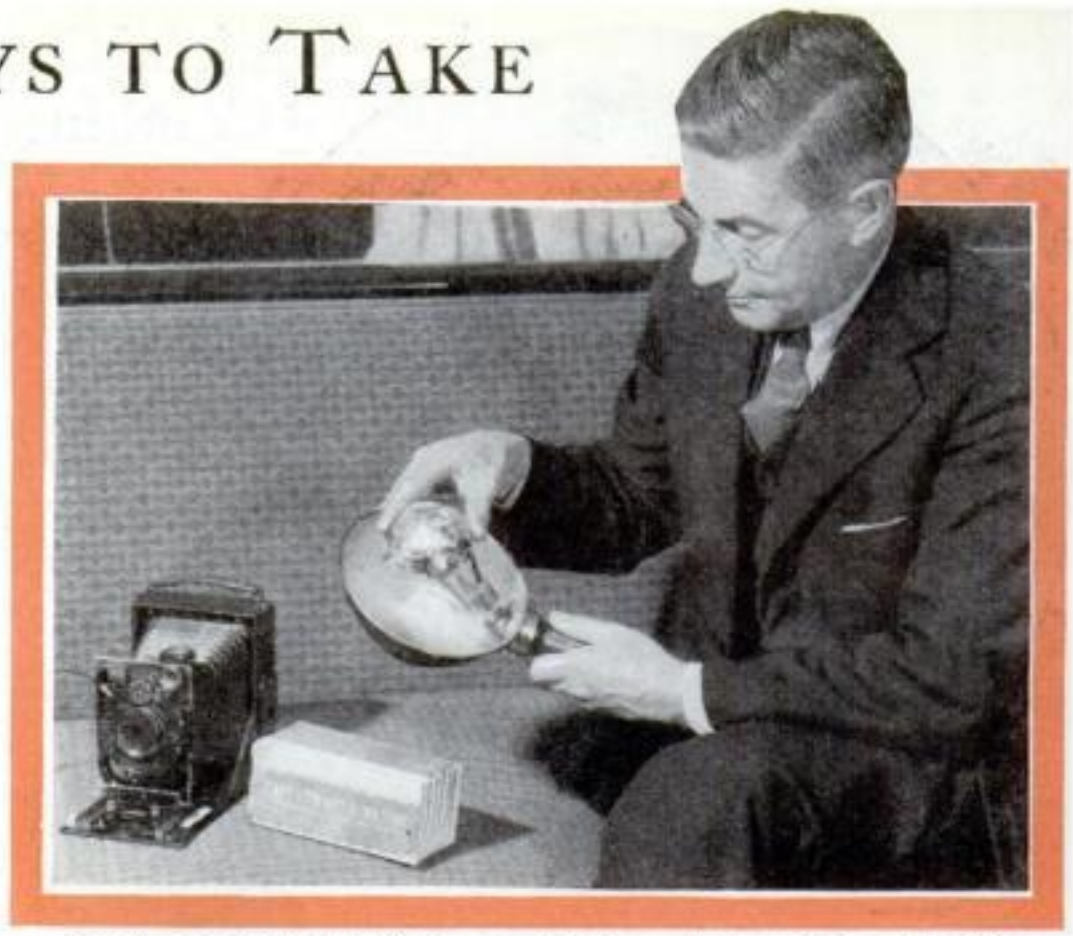
FOR model making or other small work, a surprisingly useful vise can be improvised in a few minutes from a butt hinge, an angle brace, and three stove bolts. Select a hinge having three holes in each half, and mount it at one extremity of the angle brace by means of a small bolt with a countersunk head. Place the two other bolts, which should be an inch or more long, in the end holes of the hinge. Fasten the brace to the bench top by means of two wood screws. For tightening the vise, use a screw driver, or apply wing nuts to the bolts. When a key must be filed in an emergency, a vise of this type is especially valuable. Hinges can be adapted to other purposes, too. For example, a planing stop for a woodworker's bench can be made without difficulty from a hinge sunk into a recess and adjusted by means of a wood screw.—B. E.



Above is shown how the improvised vise may be used for filing a key or other delicate work of the type so often required in model making. The view at the right is one looking down on the vise to show exactly how the hinge is bolted to its angle iron support

FOUR WAYS TO TAKE

Flashlight PHOTOS



Inserting a photoflash bulb in a combination reflector and dry-cell holder

BY FREDERICK D. RYDER, JR.

AT A PARTY I attended the other night, the host decided to take a group picture of his guests. As a substitute for a tripod, he brought out a stepladder. The second rung from the top served as a support for the camera. After he had focused it and set the shutter for a time exposure, he produced a bottle of flashlight powder and dumped about three times too much in a pile on the bare wood of the top step.

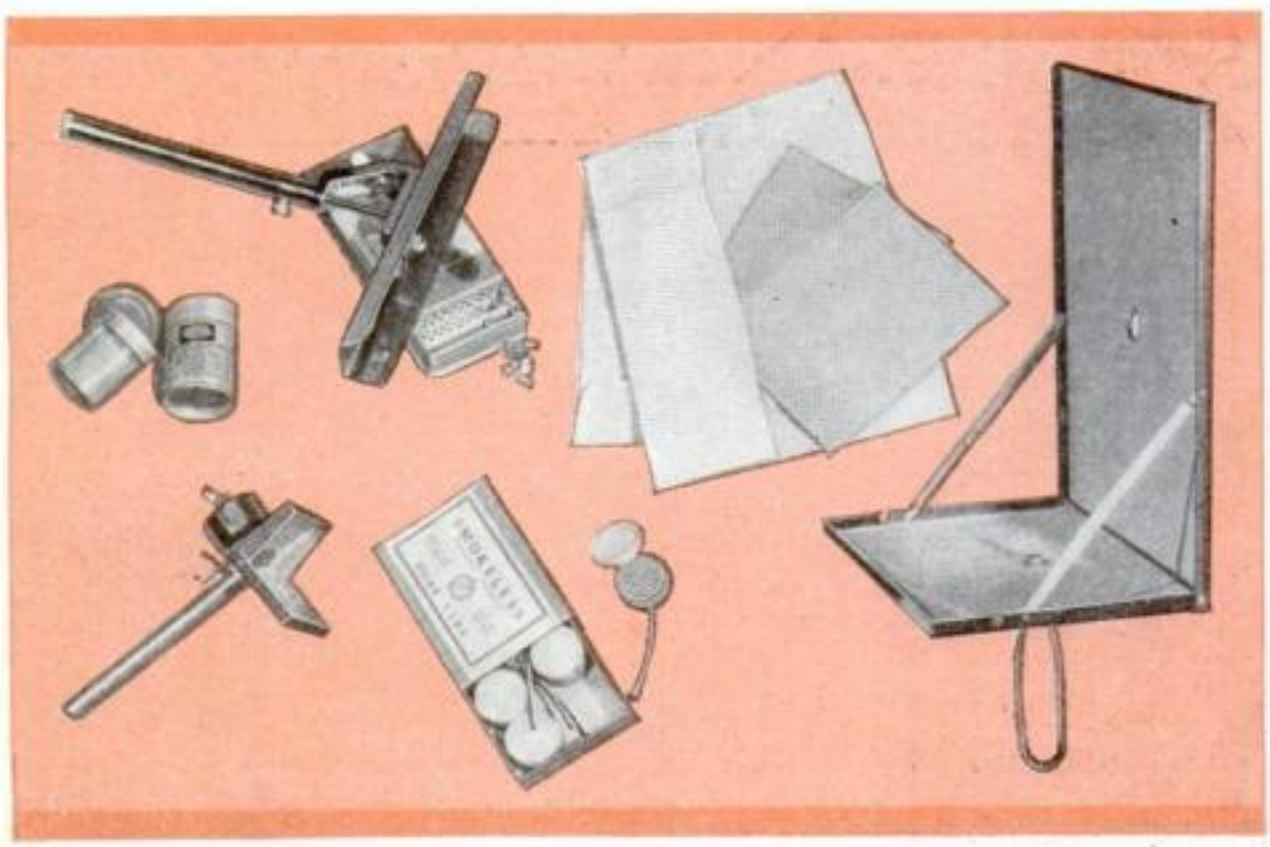
The flash powder looked stale and lumpy to me and I cautioned him about it, but he was so tickled with himself for working out the stepladder arrangement that he paid no attention to my warning.

He lined us up, opened the shutter, and touched off the flash powder with a match held in the end of a notched stick. Instead of the usual clean-cut flash, the stuff went off with a sputtering sizzle that projected two white-hot lumps over the edge of the stepladder top. One fell on the camera bellows and burned a neat hole in it; the other scorched its way through a valuable rug.

The point of this little episode is that if you want to take flashlight pictures with any flashlight material other than the recently introduced photoflash lamps, you must understand its potential dangers and learn how to use it with safety.

Last month (P. S. M., Jan. '32, p. 79) I discussed taking pictures by artificial light. Flashlight photography is just a specialized branch of artificial light photography, and the usual rules for placing the light source to obtain the proper shadows hold good for flashlights. In other words, it makes no difference whether the light is coming from a powerful electric bulb, a photoflash lamp, or burning flashlight powder; you must figure out in advance just how the various objects in the picture are to be illuminated.

There are four classes of photographic flashlight material now available to the amateur. They are flash powder, flash sheets, flash cartridges, and photoflash bulbs. Materials of the first three classes have been in use for years, but the photoflash bulb is a recent innovation. Each method of producing a powerful photographic light has certain advantages and disadvantages and it is, of course, up to you to choose the material which best fits your own particular requirements.



Two flashlight guns, one fired by small cartridgelike primers and the other by a sparking mechanism; a box of fuse-type flash cartridges; and a flash sheet holder with flash sheets

Flash powder, flash sheets, and flash cartridges are all made of the same basic material, powdered metallic magnesium, which is mixed with a powerful oxidizing chemical. The intense white light actually is produced in each case by the rapid burning of metallic magnesium.

The photoflash bulb also depends for its light production on the burning of a metal. However, instead of the magnesium used in the powders, sheets, and so on, the photoflash bulb contains a quantity of extremely thin sheet aluminum, the remainder of the space within the bulb being filled with oxygen at somewhat less than atmospheric pressure.

WHILE flash powder can, of course, be used with no other equipment than a large piece of heavy cardboard and a match, following the procedure already described, it is more satisfactory and safer to use it in one of the special flashlight guns sold for the purpose. The powder comes already mixed in glass bottles, and there are a number of types of flash guns. Two good models are illustrated at the left of the accompanying group. One ignites the powder by means of a primer that looks like a tiny rifle cartridge, and the other has a clockwork mechanism that drives a toothed wheel against pyrophoric metal to produce sparks as in the common variety of cigarette lighter.

Flashlight powder costs about 80 cents an ounce in 2-ounce bottles, and that quantity is sufficient to take dozens of flashlight pictures under ordinary amateur conditions. Flash lamps for use with flash powder cost from $2 to $5, with another using paper caps at $1.25.

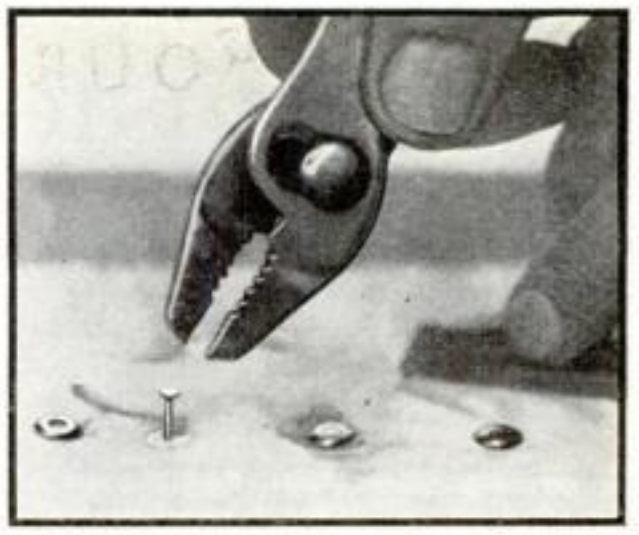
Flash sheets also can be used with no apparatus except two sheets of cardboard, but it is better to get a regular flash sheet holder, which costs about $1.25. The flash sheet holder and a package of flash sheets are shown at the right of the grouped apparatus. Six sheets cost 35 cents.

Flash cartridges, which are also shown in the group, really consist of tiny boxes of flash powder, each box being fitted with a special fuse. No apparatus is required for their use *(Continued on page 120)*

COIN TRICK PAYS MAGICIAN TEN CENTS

Most amateur magicians perform without pay, but this trick nets the performer ten cents. *Below:* The envelope turned over in the palm to show how quarter slips out

After asking your "victim" if he will pay ten cents to see a good trick, show him a common coin envelope and tell him to drop a quarter in it. As soon as he has sealed the envelope, tear it open, and out drops fifteen cents. "Here is your change for the quarter after taking out ten cents," you say, and at the same time give him the money and offer him the envelope to examine and keep as a souvenir. The explanation is very simple. On the face of the envelope, three-quarters of its length away from the flap, is a crosswise slit made with a razor blade. Fifteen cents is previously inserted in the envelope, resting in the bottom. When the victim drops his quarter in the envelope, the performer squeezes the sides slightly, which forces open the slit. The quarter then slides down and drops through the slit into the magician's palm, covered by the envelope. When he seals the flap, the performer raises his arm, and the quarter slides neatly down his wrist and into his sleeve. In tearing open the envelope, the slit is obliterated.—KENNETH MURRAY.



A SAFE WAY TO REMOVE BRASS-HEADED TACKS

GETTING out brass-headed tacks with as little damage as possible is something the home repairman often has to attempt. Prying them up is likely to mar and nick the surface and leave unsightly blemishes. This can be prevented in many cases by using a file or a flexible shaft with a small grinding wheel to remove a bit of the top of each tack, leaving only a ring as shown above. What remains of the brass head then can be picked off with the fingers or loosened easily with the point of a knife blade, and the nail itself withdrawn with small pliers. In this way it is hardly necessary to touch the finished surface of the leather, wood, or other material which the tacks held down.—F. B.

STRIPPING OFF OLD FLOOR FINISHES

After it has been softened with varnish remover, the finish is scrubbed with steel wool

WHEN a floor is in very bad condition, it is necessary to use a liquid varnish remover to strip off the old finish. Ordinarily, after the remover has been applied to a portion of the floor and allowed to work for a few minutes, the softened finish is scraped off, but there is a much easier and quicker method. Lay in a supply of No. 3 steel wool and dissolve about a third of a package of some good kitchen cleansing powder, preferably of a kind that bleaches, in a pail of hot water. Then, when the varnish remover has had a chance to soften the finish, dip a large wad of steel wool into the cleansing solution and scrub the surface well. This will remove the sludge of softened varnish, shellac, wax, or whatever the floor was finished with, and at the same time pick up the dirt and bleach the wood. Rinse the floor with clear water and allow it to dry thoroughly. Then the wood may be refinished in a natural color or stained, just as if it were new. There is one exception, however: in the case of an oak floor it is hardly ever necessary to apply a paste wood filler as would be required to fill the open grain of a newly laid oak floor.—F. N. VANDERWALKER.

SUGAR HELPS TO REMOVE GRIME FROM HANDS

TO REMOVE grease and grime from the hands, try adding a little sugar to the soap lather. The dirt will disappear like magic, leaving the hands soft and white. For this purpose it is well to keep the sugar in a tin can or a mayonnaise jar, the lid of which has been perforated with a number of holes. The sugar then can be shaken out without danger of wetting the contents of the can or jar and without loss of time.—MRS. JAMES MCCLAIN.

HOW TO USE ENVELOPE LININGS

EVERY year the linings of greeting card envelopes seem to be more beautiful in color and design. They seem to be worthy of a better destination than the waste paper basket. One good use for them is to cut them in suitable patterns and paste them in crazy-quilt designs on various novelty boxes or pieces of pottery such as the old earthenware jug, pitcher, and sugar bowl illustrated below. The edges of the individual pieces of paper are then outlined either in black paint or gold, and the whole is shellacked and allowed to dry.—P. H.

Old pieces of earthenware richly decorated with the linings of fancy envelopes

Television Scanning *and Synchronizing*

BY THE BAIRD SYSTEM

JOHN LOGIE BAIRD, *the inventor, explains the general method to be used in receiving his new 1932 American broadcast experiments*

By George H. Waltz, Jr.

Mr. Baird and one of his television developments—a receiver that reproduces the television images in stereoscopic relief

"EIGHT-PIECE jazz bands and outdoor events will be seen as well as heard in American homes when I complete my plans to broadcast television programs from station WMCA in New York City." This is what John Logie Baird, famous Scottish television expert, told me the other day when I visited him during his stay in New York.

I was amazed when he spoke of the detail obtained in English television experiments and outlined his plans to broadcast in America—held up only temporarily pending the issuance of a Government license. As he described the apparatus he used in televising plays and the finish of the last English Derby at Epsom Downs—a duplicate of which is being installed at station WMCA—I realized that if I were to take advantage of these superior programs I should have to know what differences in the English apparatus and methods of transmission and reception made such detail possible.

Here I was sitting in the same room with one of television's greatest experimenters, free to ask any questions that came to my mind. In arranging this meeting, Don Marshall, who had helped me build my own receiver as described in the preceding seven articles in this series, had again added a valuable episode to my television experiences.

"Does the English system of scanning differ greatly from the American method?" I asked Mr. Baird when the opportunity to interrupt presented itself.

"In theory, no," Mr. Baird replied, "but in practice, yes. In England, while we also use the ordinary disk, we have found that thirty square holes arranged in the scanning spiral are sufficient. In America you use twenty pictures a second, and in England we present but twelve and one half in the same time. Also, we view the image at the side of the disk rather than at the top as is the practice in systems used in America."

"In your system then, you scan the image vertically rather than horizontally. Is there any advantage in doing this?" I asked, eager to learn the details.

"Yes. The human eye, through training, is fairly well accustomed to following horizontal movements and for this reason any deficiencies in the horizontally scanned image are more noticeable. With vertical scanning," Mr. Baird pointed out, "the combination of the vertical scanning and natural horizontal eye movements tend to give a smoother, more blended television image."

"In other words," I suggested, "you scan from bottom to top and from right to left in your system instead of from left to right and from top to bottom as we do in this country?"

"That is right. Of course," Mr. Baird continued, "we also make use of what is known as 'graduated exploration.' With this, the transmitting disk is supplied with three rectangular holes at the beginning and end of the spiral while the remainder of the holes are square. These rectangular holes, as you can no doubt readily see, give the effect of concentrating the detail where it is most useful and make it possible for us to obtain greater detail under the limitations of the wave band available. In America, experts seem contented with the round scanning hole, but in England, through experience, we have found that the square shape is better."

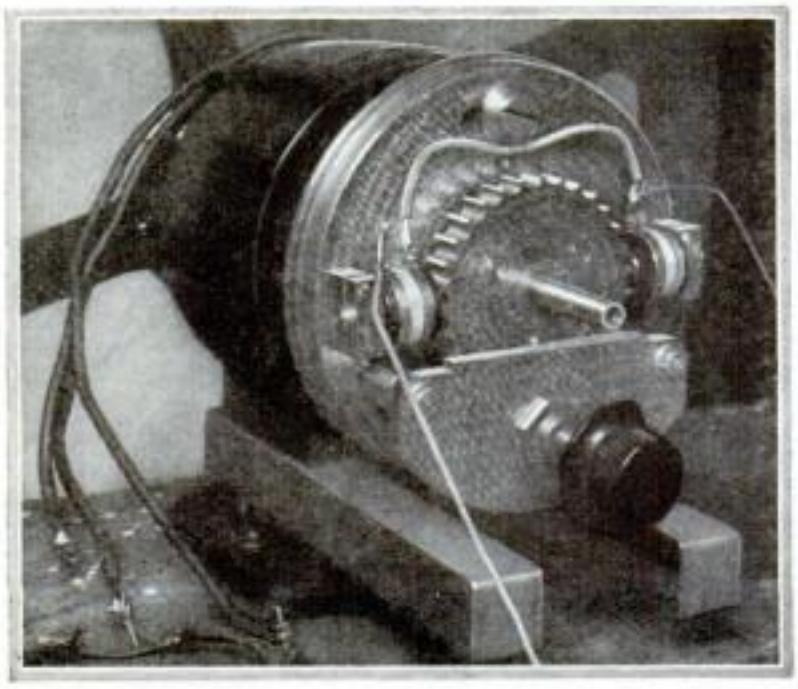
"Will you use your own system when broadcasting television in this country?" I asked, remembering what had been said regarding American broadcasts over station WMCA.

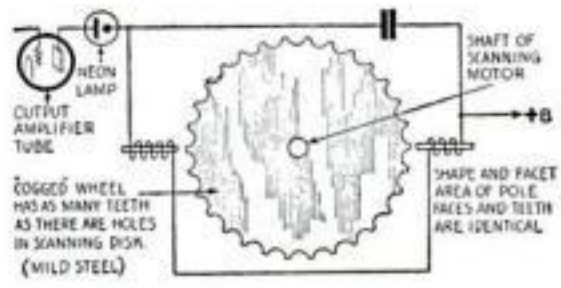
"YES. Of course," Mr. Baird added, "we will alter our methods and equipment sufficiently to conform to the sixty-line scanning and twenty pictures a second which have been adapted as more or less standard in this country."

Hoping to get some advice regarding the design of a television receiver for the American amateur, I next asked Mr. Baird what he considered to be the best combination of radio-frequency and resistance coupled amplifier stages.

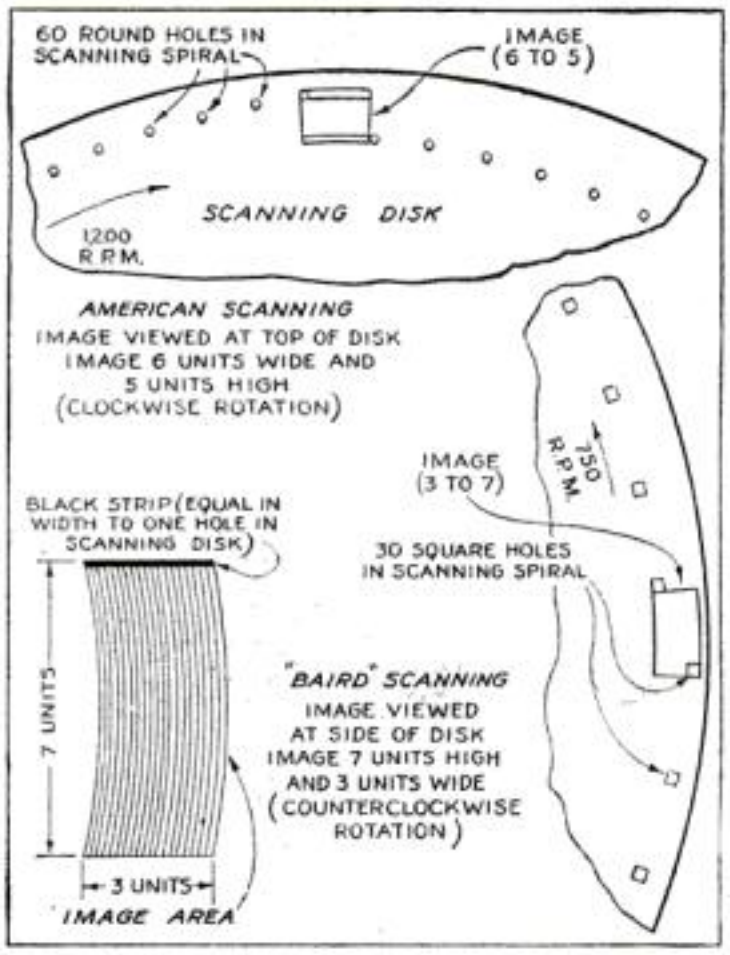
"To begin with," Mr. Baird replied, "excessive regeneration in television is entirely undesirable, as you no doubt already know. As to the number of radio-frequency stages to be used, that is a question governed almost entirely by the relative locations of the receiver and transmitter. The logical procedure is to try one, then two, and perhaps three stages, retaining the arrangement which gives the best results for the case in hand. The resistance coupled amplifier should have at least three stages."

"Are the televisors now in use





The "cogged wheel" synchronizing device used on the Baird receivers. A diagrammatic sketch showing how the mechanism is connected is given above



Sketches showing clearly the basic differences between the Baird and the American scanning systems

in England of the so-called 'peephole' variety or are projection sets used that give a large image which can be viewed by a group of people in a well-lighted room?" I asked.

"At the present time amateurs in England use the 'peephole' set and obtain an image about one and one half inches square with a twenty inch diameter disk. In our laboratory, however, we have a projection set which gives a large image on a screen and can be used in broad daylight. This projection apparatus, which makes use of the mirror drum and a modulated arc, is to be offered to the public soon."

"The big problem which confronts the amateur in this country," I explained, remembering my own experiences, "is to obtain perfect synchronism between the receiving and transmitting disks. How do you effect synchronization in England? Do you use the device sometimes referred to as the 'phonic motor'?"

"Not exactly. Our synchronizer," Mr. Baird explained, "makes no pretense to be anything in the nature of a driving force, but is merely a correcting device operated by the brief impulse caused by the black line which divides one image in the series from another."

"What black line are you referring to?" I asked, puzzled.

"In England at the transmitting end," Mr. Baird explained, "a gate or mask is used to cut down the picture area in such a way that one hole leaves the area a moment before another appears. In other words, the width of the gate is less than the distance between any two adjacent scanning holes, thus serving to form a black unilluminated strip at the top of the received image. It is this strip which forms three hundred and seventy five definite impulses a second, and it is these impulses which we impress upon the synchronizing device. This consists of a small toothed wheel attached to the shaft of the driving motor and revolved between the poles of an electro-magnet."

"Isn't that quite like the 'phonic motor' arrangement?" I suggested.

"Not exactly," was the reply. "The phonic motor is merely a simple form of synchronous motor, operated by an amplified portion of the television signal. No amplifiers are needed with our automatic synchronizer, and its action is similar to that of a brake applied to the driving motor shaft. In use, the driving motor is set to revolve in excess of the desired speed, and the action of the synchronizer slows it down just enough to hold the picture steady for long periods."

Eager to learn more about the interest the English public had in television, I asked Mr. Baird how many television amateurs had receivers in England.

"From the impressions I have obtained so far in my visit, I should say that there was more interest in this country," Mr. Baird replied. "At the present time there are about eight thousand television receivers in England."

"Do you use scenery, properties, and make-up in your broadcasts?" I asked.

"Yes. With the clarity we obtain in our transmissions," Mr. Baird related, "we have found it necessary to make use of all three. In one broadcast not so long ago, a play was being given. As the four players went through their lines, they reached a point where port wine was to be served. Not having a bottle of port handy at the studio, we substituted a bottle bearing the label of a famous brand of champagne. No sooner had the play ended than one amateur called us on the phone asking that we be more particular as to the detail of the properties used. This observer had been able to recognize the bottle."

Another article on television by Mr. Waltz is scheduled for publication next month.

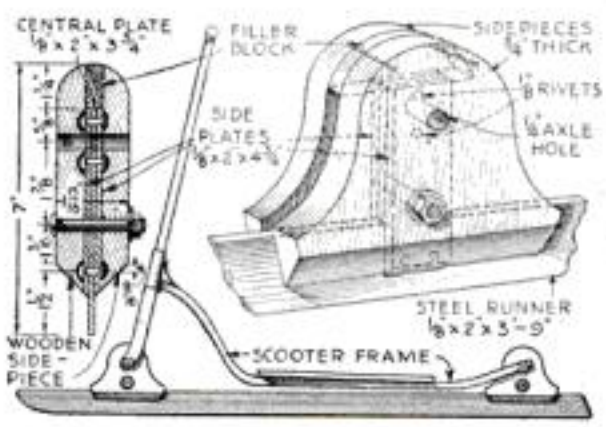
CONVERTED SCOOTER GIVES FUN ON ICE

WITH its wheels replaced by a long steel runner, an ordinary toy scooter will afford plenty of fun on the ice both for those who skate and those who don't, not to speak of the spectators. It will also travel well on icy sidewalks or pavements and even on hard-packed snow. High speed can be attained and, after a little practice, figure scootering can be done, especially if the runner is made rocker shape toward the ends. Steering is accomplished by turning the handlebar, which bends the runner, and also by shifting your weight after the manner of a skater.

First, remove the wheels from the scooter. Then prepare two metal clamps or holders for attaching the blade to the scooter framework. Each of these consists of one central piece of cold-rolled steel ⅛ by 2 by 3¼ in. and two side-pieces ⅛ by 2 by 4¼ in. (unless the design of the scooter is such as to make it advisable to have them longer). The three pieces in each set are held together and drilled as shown with one hole for the scooter axle (usually ¼-in.) another ¼-in. hole for a bolt, and four ⅛-in. holes for rivets.

Cut and shape four wooden side plates from ¾ in. thick hardwood and two filler blocks to go between each pair above the steel pieces, as illustrated. Bore the wooden side plates for the axle and bolt holes and gouge indentations at the points where the rivet heads will come. Hacksaw and file the runner to shape from a piece of cold-rolled steel ⅛ by 2 in. by about 3 ft. 9 in. Drill it to suit the rivet holes at the bottom of the metal clamping pieces which are to hold the runner in place.

Assemble the metal parts as shown and bolt on the wooden side plates. Secure the filler blocks in place with finishing nails. Then attach the runner blocks to the scooter by slipping the axles through the axle holes and setting the nuts up fairly tight. Paint the blocks a color to match the remainder of the scooter.—JACK HAZZARD.



How the clamps for holding the steel runner are made and fastened to the scooter frame

Nonskaters as well as skaters can venture on the ice with a scooter

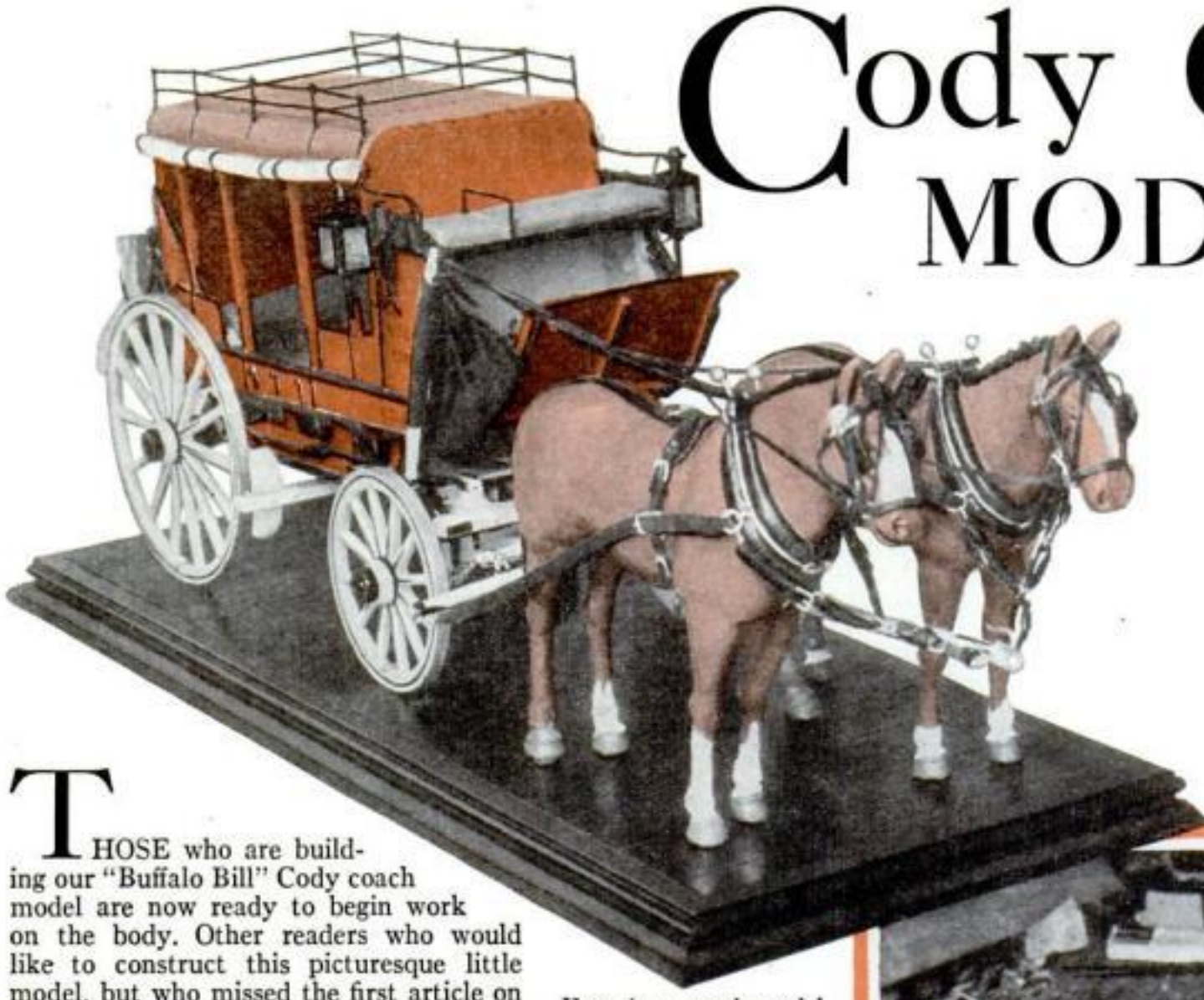
APPLYING TRANSFERS

WHEN decorative transfers or decalcomania designs have to be applied on woodwork, furniture, and novelties of any kind, it helps a good deal to use an electric iron which has been allowed to reach a gentle heat. Thin blotting paper should be placed over the transfer. The warmth dries the cement quickly, and the edges do not tend to curl away from the wood.—K. L. J.

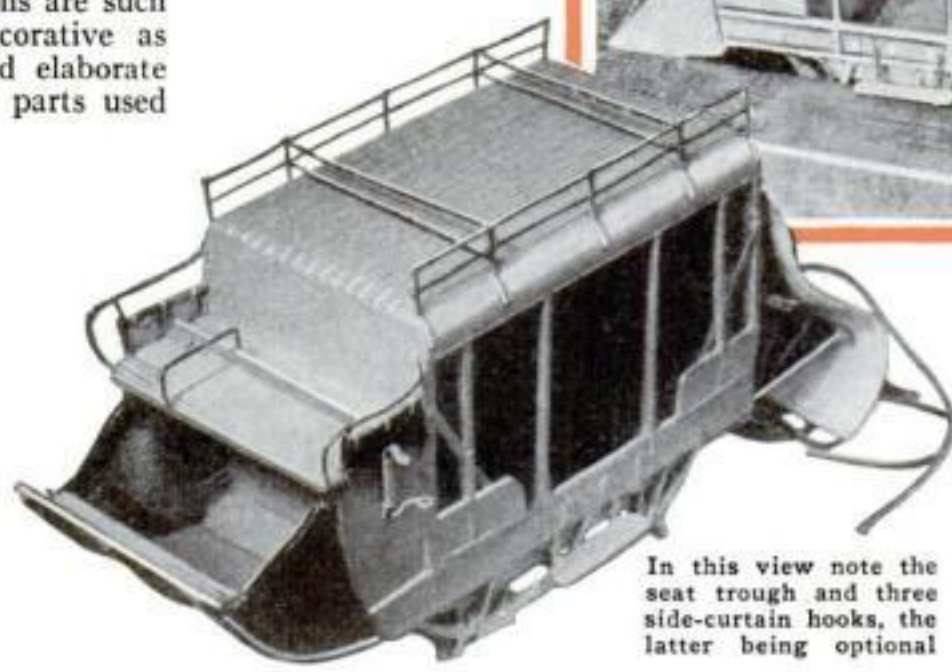
EDWIN M. LOVE *tells how to construct the body of our new*

Cody Coach MODEL

A Picturesque Miniature of Buffalo Bill's Famous Old Wells Fargo "Mud Wagon"



Here is a coach model that has the real color and feeling of the Wild West. It is an exact miniature of an open "mud wagon" driven by Cody between the towns of Leavenworth, Kans., and North Platte, Neb.



In this view note the seat trough and three side-curtain hooks, the latter being optional

Driving in a brad to serve as the post for supporting a wire seat rail, which is then soldered to it

THOSE who are building our "Buffalo Bill" Cody coach model are now ready to begin work on the body. Other readers who would like to construct this picturesque little model, but who missed the first article on the undercarriage (P.S.M., Jan. '31, p. 73), can catch up without difficulty by sending seventy-five cents for POPULAR SCIENCE MONTHLY Blueprints Nos. 144, 145, and 146 (see page 107). These contain full size drawings of all parts.

The body, open sided as it is, does not require nearly as much work as an inclosed coach, yet its proportions are such that it is as beautifully decorative as many a more pretentious and elaborate cab. All unfamiliar names of parts used in the following instructions can be identified at a glance by referring to the drawings on Blueprint No. 145.

TOP. Shape a pine block 5/8 by 6 9/16 in., and hollow the underside full length. A dado saw is excellent for this work, but the depth of cut must be reduced at the edge to allow for the rounded corner. Rabbet the sides for the curtain beads. Round the upper corners, sand, and glue muslin on the underside, painting the cloth red.

ENDS. Bandsaw from 1/2-in. (or thicker) pine. Notch the edges for the side boards and seat ends, and the fore end for holding the back edges of the wooden boot sides below the driver's seat. Smooth, and line the rear end with muslin, painting it red.

FLOOR. Note the lengthwise section (Blueprint No. 145). The fore slope, after assembly, is a continuation of the fore end; but the hind slope is at the seat front, giving floor clearance over the hind axle. Use hardwood for the parts. The ends are the width of the sunken floor plus the width of the two sills. Glue the slopes to the end floors, holding the latter in a vise while driving the pins. To avoid splitting, drill holes with needles smaller than the pins. Then clamp the center floor and attach the end parts. Add the bed side boards, gluing the sills to their upper edges.

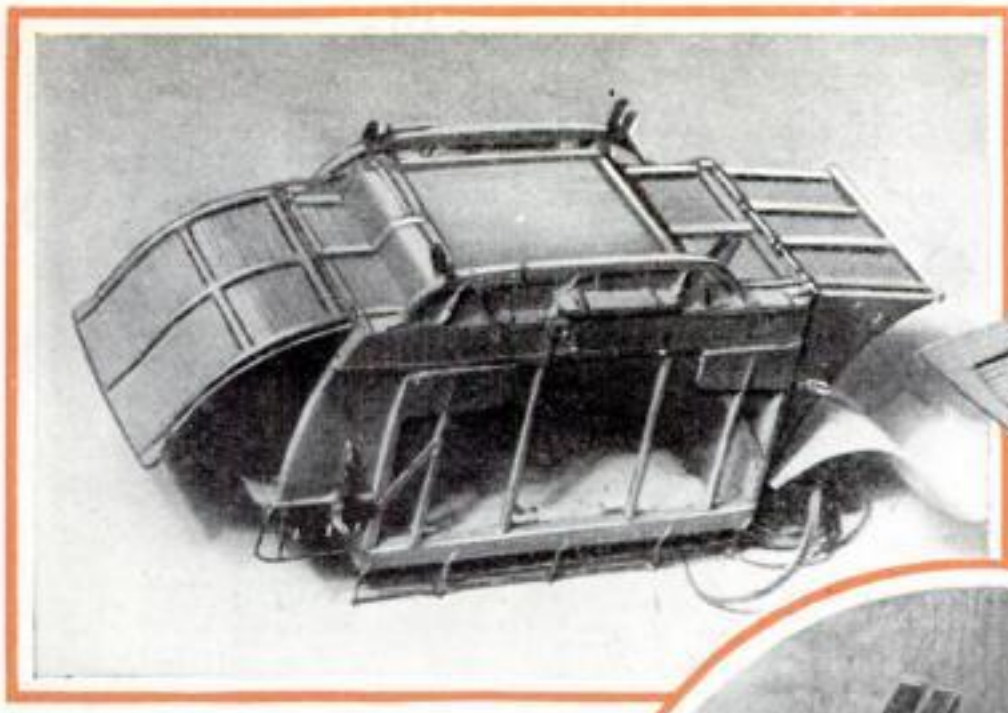
Sideboards: These are convex in section and extend the full length of the body, including the wooden boot sides. Glue the lower edge to the bed sides, drill, and drive in pins. Cut off these inside, leaving enough to rivet slightly.

Runners: Attach the irons to the wooden runners, and make the brackets, which are pinned into the sideboards. The distance between the two runners is regulated by the thorough-brace shackles on the carriage.

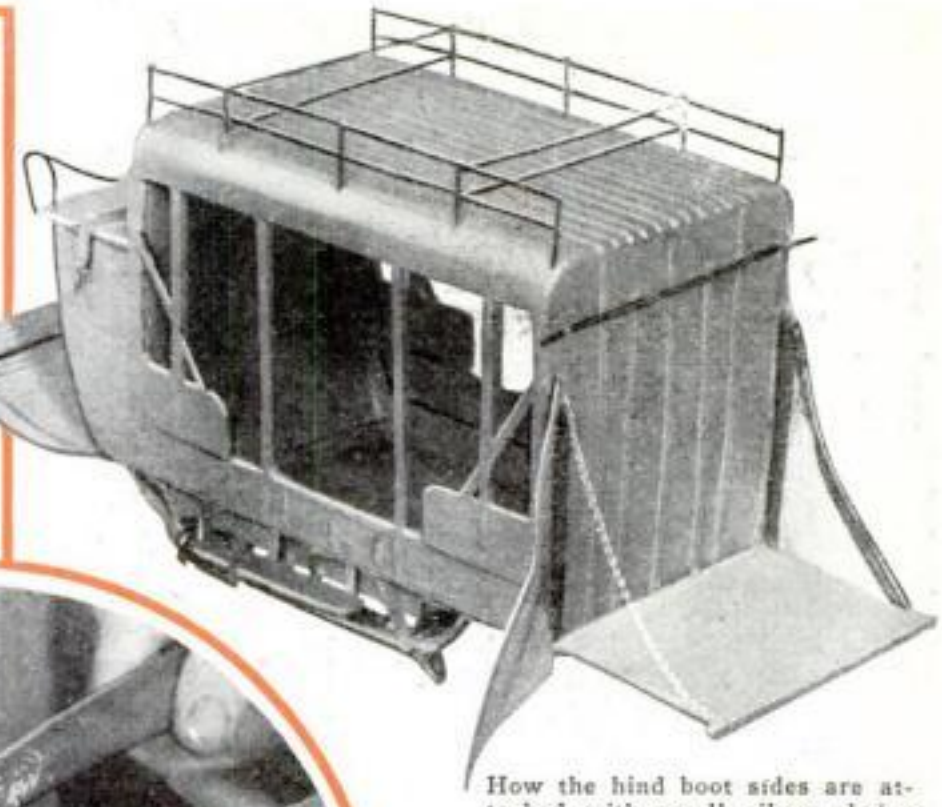
BOOT FLOORS. *Hind:* The four cleats carry half-hinges of sheet metal folded around No. 18 wire. The long end cleat has hooks made of pins set diagonally through the ends.

Buckles: Bend a rectangular loop in a pin. Cut a 1/32 by 1/8 in. strip of leather, using for a tongue a pin with the head crushed flat sidewise with pliers. Fold the leather under, inclosing the back end of the loop, and glue, pressing flat. Trim to length, fasten a narrow leather clasp around behind the buckle with the ends glued behind, and cut the tongue to length. Glue the leather to the floor, and "bolt" with a pin cut off flush with the inside of the floor. To simplify the boot floor, if desired, make it of wood as thick as the floor and cleats combined, and omit the buckles.

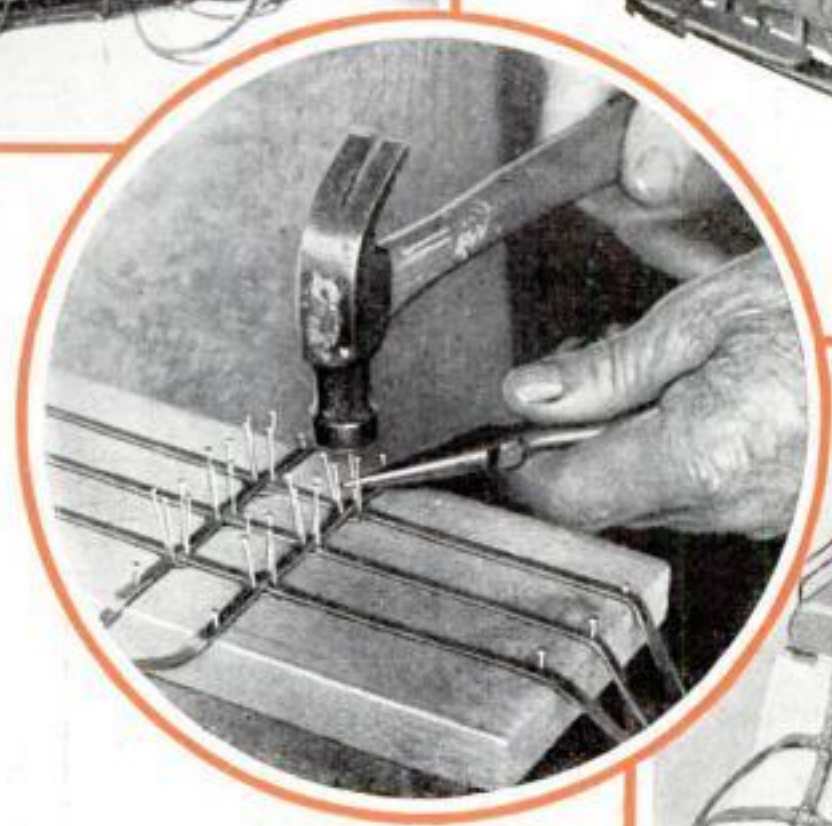
Fore: Cut the cleats to a sharper curve



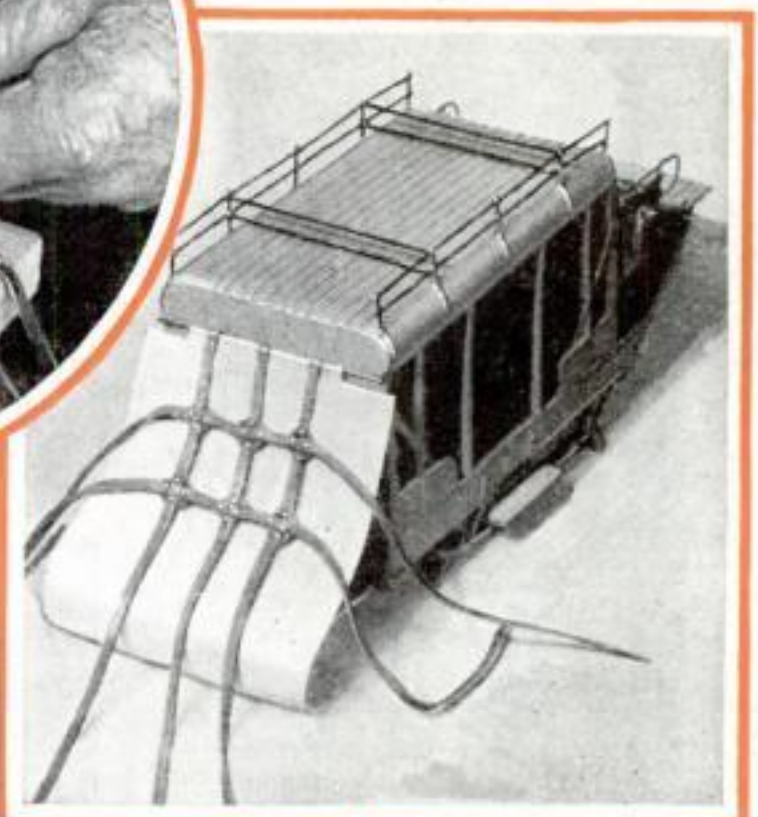
This is how the body looks from the underside. Complete constructional details are given in our coach model Blueprints Nos. 144, 145, and 146



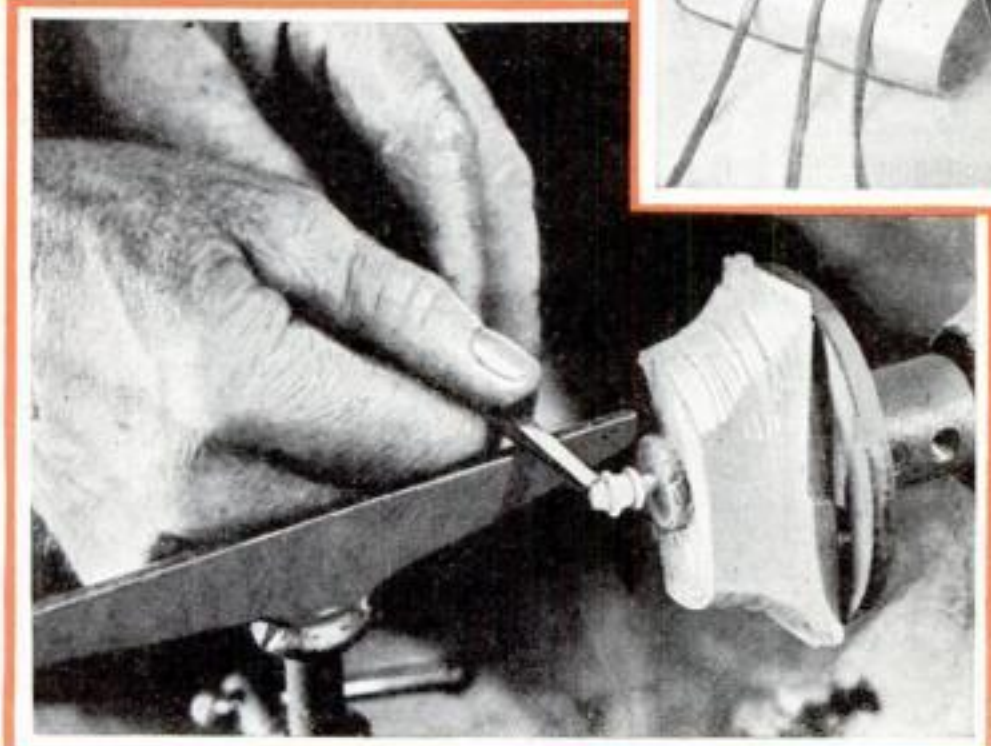
How the hind boot sides are attached with small silver chains obtained from a ten-cent store



The method to use in assembling the hind boot straps. The pins are pulled through to their heads, cut off, and then bent over



The assembled boot cover. Do not allow these photos to deceive you as to the size of the model. It is really a small and simple one—6 in. wide, 8¼ in. high, and 21 in. long including the two horses



The top ventilators for the lamps are turned by screwing a block on the faceplate, making a hole, and pushing in the stock

than drawn, so that the pressure of the floor, as it is shaped by them, will spring them to the proper profile. Dampen the underside of the floor with water to warp it (the grain runs crosswise) and glue and bolt while wet. Make the dashboard as a separate piece, and after placing it add the horizontal foot rest with the three triangular brackets. Do not forget the two half-hinges or the hooks.

Wooden Sides: These may be made of cardboard or metal. Glue on the front posts and bristol-board cleats.

DRIVER'S SEAT. Note the rabbeted ends and front edge. Add the trough front and glue and pin the seat to the fore end, which is then lined with muslin and painted.

ASSEMBLY. Shape the top ends to receive the upper edges of the body ends, attach the latter, and add the bed. Brace the body temporarily, and attach the side boards. Glue the bristol-board beads to the sideboards. Glue the rear edges of the boot sides into the fore-end notches, and the tops into the seat-end rabbets, while the projecting posts lap behind the sideboard ends. Fill out the body-end edges over the boot sides with thin wood. Shape the seat ends and their cleats, and attach, keeping the solid ends flush with the sideboards and the inner ends projecting beyond almost to their thickness.

Posts: Note the curved sides, and the upper ends notched into the top. The lower ends notch over the sideboards and seat ends, lapping inside; and while the center posts are vertical, the others flare outward toward the bottom.

Braces: The upper ends enter the body-end notches and fold over front and back, being bolted there with pins. Notch the seat posts halfway for the irons, filling in above with composition wood. The lower ends are bent inward at right angles at the cleat, resting on triangular blocks through which they are bolted to the cleats. The strap braces are continued as brace rods glued inside the sideboards.

Other Irons: Glue cardboard irons over the lower ends of the posts. The top is protected with thirteen cardboard strips. The rear end has three strips full height, with two shorter metal strips that bend into hinges at the bottoms. The upper ends bend over the curtain rod after the canvas cover is placed. Notice the thorough-brace clips, pushed through notches in the wooden runners and bent into inverted "U's", and the rub irons, made by folding sheet metal halfway back on itself. Add the bottom straps and hinges. The ends of the tie straps clasp over the end brackets, being bolted to the runners and bent down outside.

LAMPS. *Top and Bottom:* These are wood. *Sides:* Glue celluloid over the lights to represent glass, and lap the ends full width. Gild the insides of the tops and bottoms before inserting, and glue tin foil reflectors to the cardboard. *Brackets:* These are metal.

RAILINGS. *Top:* Use brads for the posts, and solder the wires to them. *Seat:* The ends of the side rails are glued in holes, the cardboard shanks being added.

In the next article the boot equipment, steps, seats, curtains, hind boot cover, and painting will be described, together with directions for carving horses, making harness, and mounting the model.

New Ideas TO AID ALL WHO WORK ON CARS

IN COLD weather, the wooden rim of a steering wheel may get so cold it will chill the hands when first grasped. Modern steering wheels, however, are rimmed with a molded composition that is a far better conductor of heat than is wood. Chilly fingers caused by modern steering wheels can be prevented by wrapping the wheel rim with a layer of wool as shown in Fig. 1. Wool Army puttees are suitable for the purpose. The winding must be tight and the ends of the puttees should be cemented firmly to the wheel.

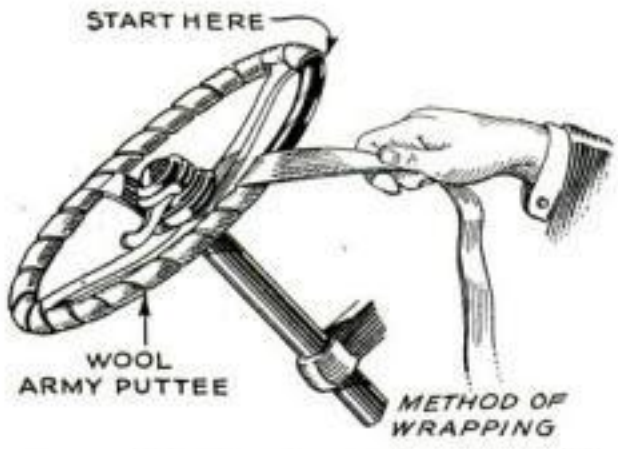


Fig. 1. Wrapping the steering wheel with wool protects the fingers from its chilling rim

Missing at High Speed

AS A CAR gets older, joints in the frame and motor mounting loosen and this often causes queer troubles with the ignition system. A motor may, for example, hit evenly on all cylinders at low speeds but develop a bad miss at high speed. Often this miss can be eliminated by connecting a wire from the metallic part of the ignition head to the nearest point on the frame, as shown in Fig. 2. Sometimes, however, it is more effective to run a flexible wire from a convenient bolt on the crank case to the frame of the motor.

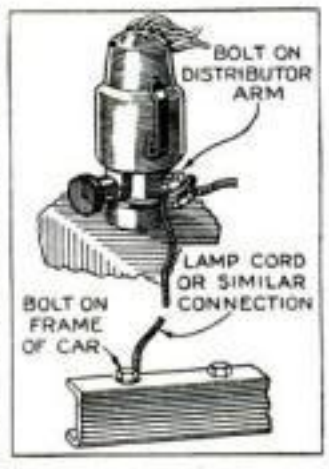


Fig. 2. Wire from ignition head to car frame stops motor's missing

A Cut Tire

OCCASIONALLY a tire is badly cut by a broken bottle or piece of metal long before the casing is worn out. Figure 3 shows a way to hold the cut together and prevent undue wear on the blowout shoe. Use wire staples as indicated to draw the edges of the cut together. The ends of the staples should be clamped tightly against the outside surface of the shoe. Even if they are in such position that they become worn away, the air pressure will still hold the staples in place. Sketch in lower left-hand corner of page shows the idea.

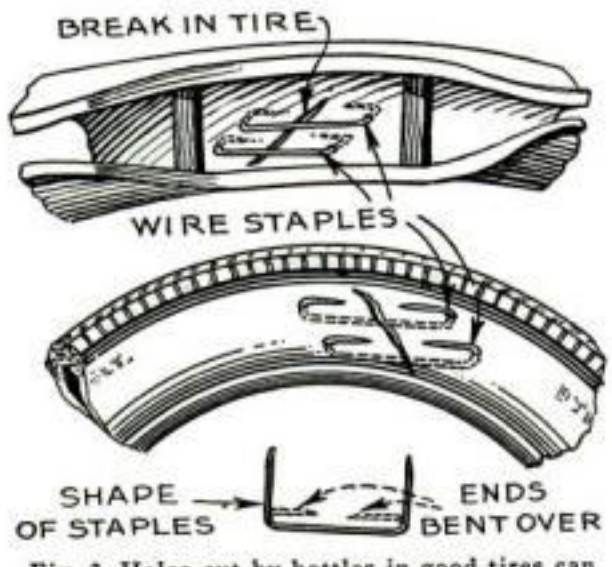


Fig. 3. Holes cut by bottles in good tires can be mended by stapling the cut edges together

New Tire Tool

Fig. 4. A hook on a short iron catches spoke and helps in getting tire off sticking rim

IN THEORY, it is an easy job to remove a tire from a rim, but often the tire is stiff and hard to spring. Figure 4 shows a tool that will help. An extra short iron is fitted at the hand end with a hook-shaped bolt passed through a hole and held loosely in place with a nut, the end of the bolt being riveted over. The tire is first started with a regular iron and then held as shown with the special tool while an additional section is jacked off.

A Clip Tong

THE modern auto mechanic can take a tip from the old-time blacksmith. The blacksmith's clip tong, shown in use in Fig. 5, is one example. The handle ends of ordinary tongs are altered by cutting one a half inch shorter, flattening a trifle, and forming the end to a shallow crotch shape. The other handle end is given a short right-angle bend. The drawing shows how the clip tong is used to pull into line a shackle clip. A powerful pull can be exerted with little effort by means of this tool.

Fig. 5. Blacksmith's clip tongs can be used on car

WIN A $10 PRIZE

Each month we award $10 for the best idea sent in for motorists. This month's prize goes to Edward E. Leinen, Rochester, N. Y. (Fig. 6). Contributions are requested from auto mechanics and if published will be paid for.

Your Back Curtain

INSTEAD of the sloppy appearance of a rolled back curtain, the arrangement shown in Fig. 6 provides a neat way to support the curtain flat against the underside of the top. It also provides a place to store robe, blanket, or heavy coat when the back curtain is down.

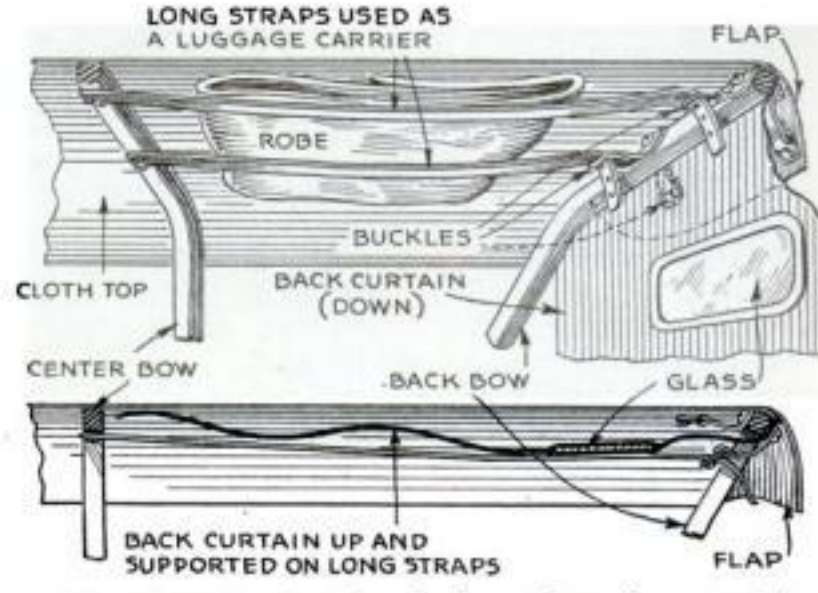
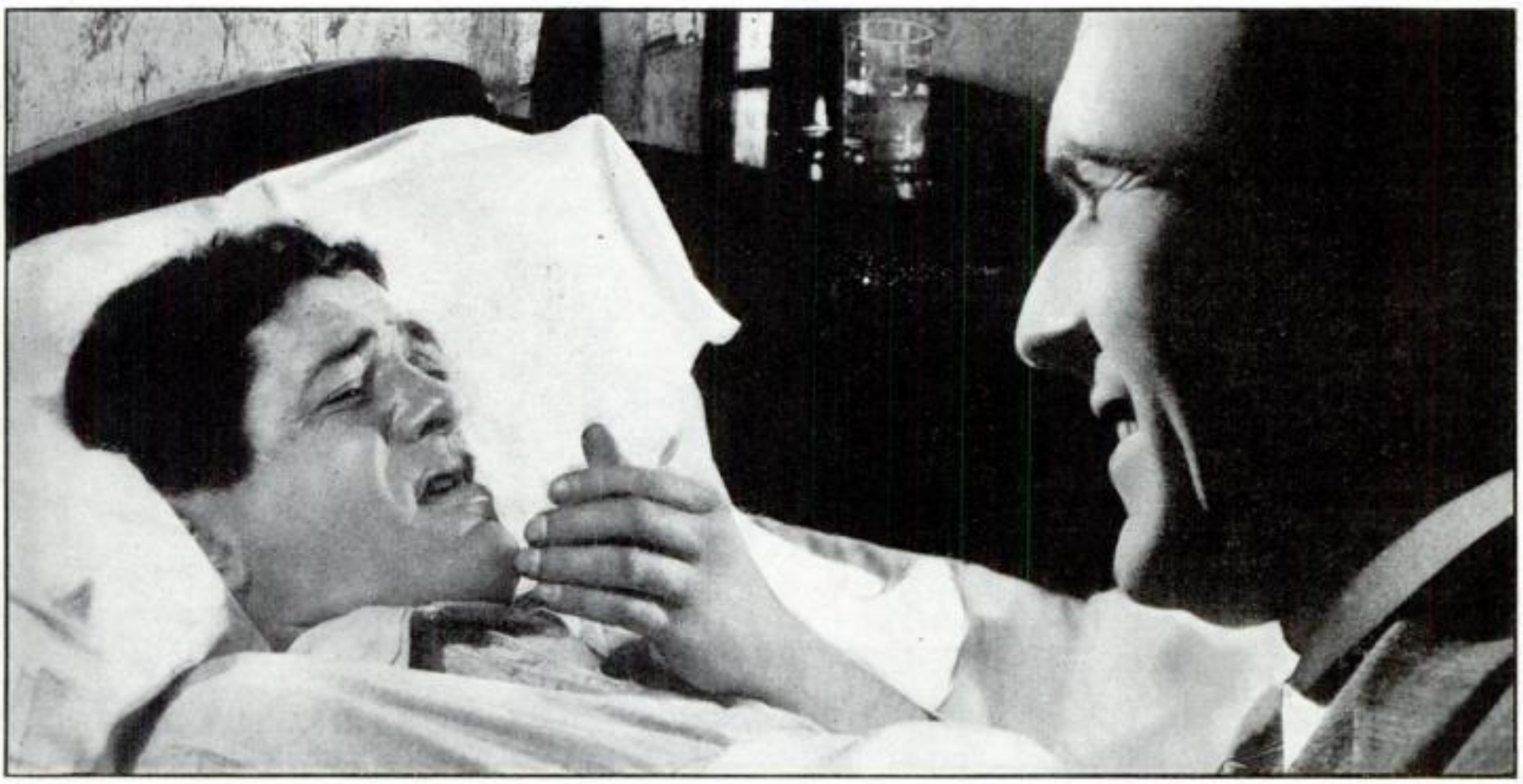


Fig. 6. Drawing shows how back curtain can be supported flat against car's top and rack also used to carry a robe

"COUGH, *you chump* . . it's all your own fault"



Now millions prevent colds by twice-a-day *Listerine Gargle*

66% *reduction shown in tests*

Now people are beginning to realize that if they have a cold they have only themselves to blame.

They are learning that ordinary colds can frequently be prevented . . . their number often reduced 50% and sometimes 66%. One cold a year instead of three.

Twice-a-day Gargle Does It

Wise eating, moderate exercise, ample rest are half the battle in warding off colds. The other half is the systematic twice-a-day gargle with Listerine, the safe antiseptic.

For Listerine, by scientific tests, is revealed as a splendid aid in preventing colds and reducing their severity and duration. Never have its swift germ-killing power and safe healing action been so clearly disclosed. Below is a brief outline of one of the many tests and its results.

One-half as many Colds

204 persons in normal health were under medical observation for a period of one month to four-and-a-half months. One-third of them did not gargle with Listerine. One-third gargled twice a day. One-third gargled five times a day.

Now, note these results:

Those who gargled with Listerine twice a day had from 50% to 66% fewer colds than those who did not gargle with Listerine.

Colds ¼ as Severe

When Listerine users did contract colds, they were one-fourth as severe and lasted only one-third as long as the colds contracted by those who did not use Listerine. Those who gargled five times a day showed even greater resistance to infection.

Safety is Answer

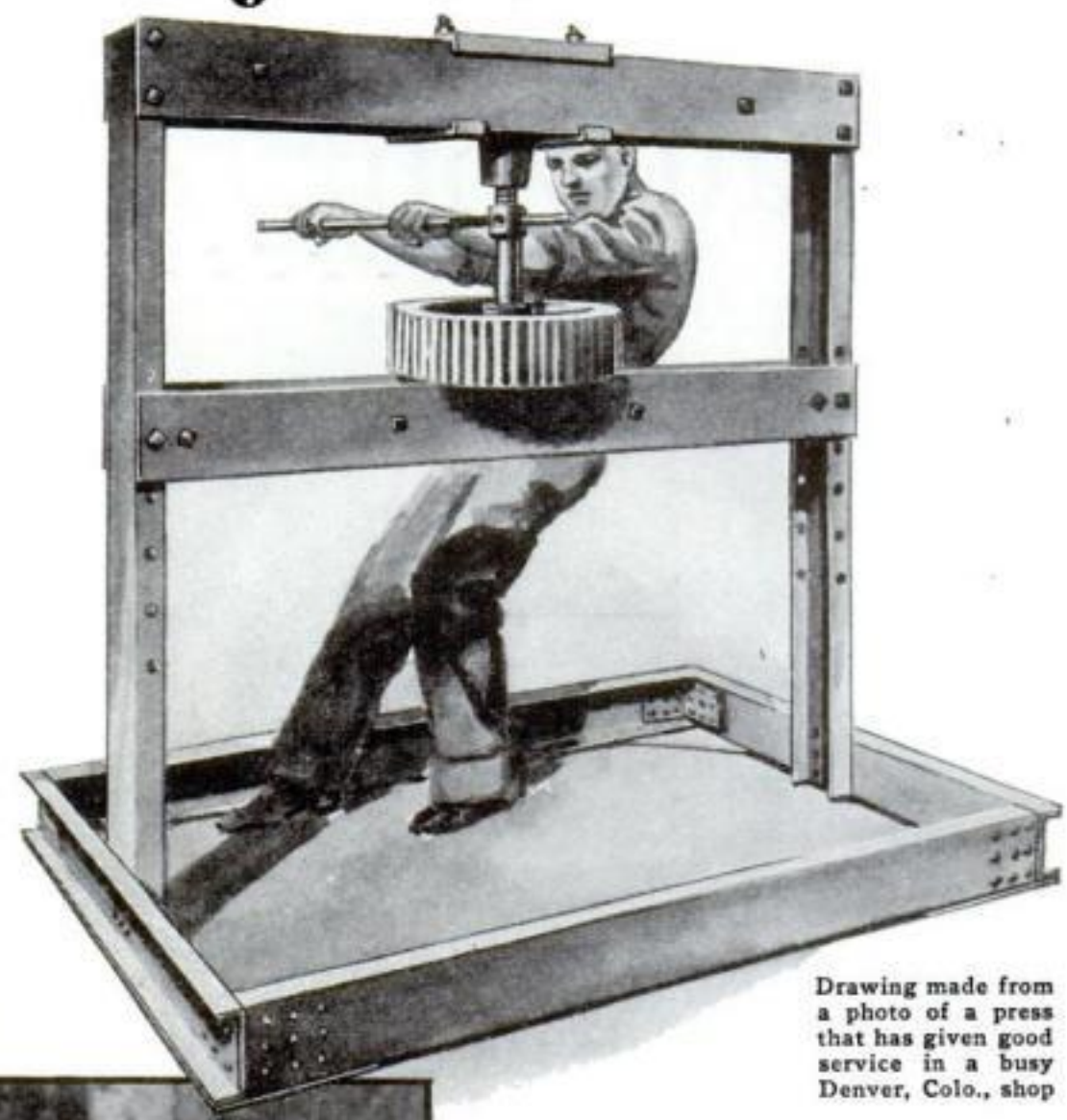
Only a mouth wash combining the factors of swift, germicidal effect and safe, healing action could accomplish such results. Physicians tell us that mouth washes so harsh they must be diluted before they dare be used, may, and often do, cause irritation through which germs usually enter the body. Lambert Pharmacal Co., St. Louis, Missouri.

Tried it?
LISTERINE RUB
a NEW SALVE for the quicker relief of coughs and irritation

Listerine . . . effective because SAFE!

SHOP PRESS *uses* Jack *for* Power

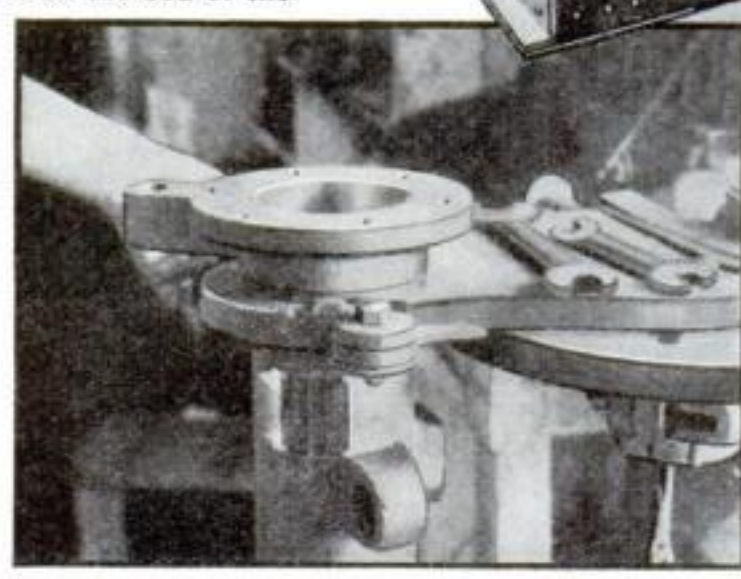
A SERVICEABLE press for the shop may be made at a fraction of the cost of a new one by using a jack with a heavy steel screw to provide the pressure. The uprights for the frame are of 8-in. channel steel, with a number of ¾-in. holes drilled in the flanges. The framework at the floor is of similar material. It must be strongly riveted or bolted to the uprights and provided with additional bracing, if necessary. The four main longitudinal members are of 1 by 8 in. steel bolted to each edge of the vertical channels; and the lower pair, on which the work is placed, may be moved up or down by means of bolts passing through the holes already mentioned. The base of the jack is welded to a 12 by 16 in. section of 1 in. thick plate, flanged at each edge. This is inverted on top of the upper frame members and attached by four ¾-in. bolts to a pair of 1 by 4 in. clamps, flanged at the ends and placed under the upper frame members. By loosening these bolts, the jack may be moved along to any place on the frame, which is made wide enough to admit an automobile axle for straightening. Short channels are placed across the adjustable members on which to lay the work. The screw is turned by means of a long bar.—JOSEPH C. COYLE.



Drawing made from a photo of a press that has given good service in a busy Denver, Colo., shop

CLAMP GRIPS END OF LONG WORK TO BE DRILLED

IN DRILLING holes in the flange of sections of pipe or other long castings, it is often impossible, because of the length of the work, to locate it on the bed of the drill press. In such cases the work may be placed on the floor or other substantial base and the upper end clamped to the edge of the machine table for drilling. For this purpose a semicircular clamp of 1 by 1½ in. steel can be used to advantage, as illustrated at the right. It is hinged at each end by means of a bolt to a section of 1-in. plate, which is rounded or otherwise shaped at its outer end to fit the work and is bolted to the bed of the machine. Of course, the usual care must be taken to get the work lined up with the axis of the press.—C. J. L.

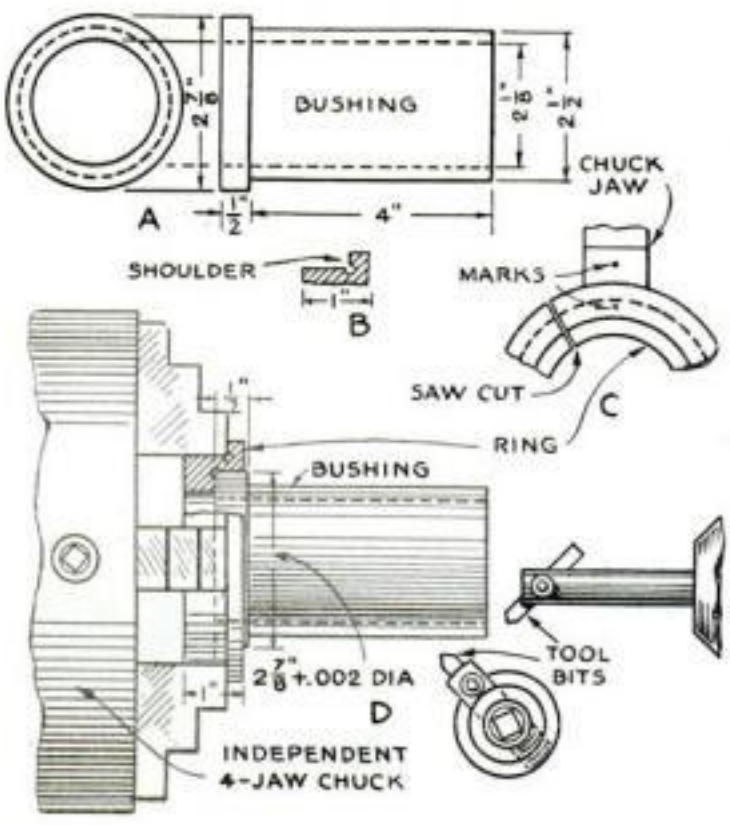


REDUCING THE BREAKAGE OF SMALL DRILLS

WHEN a portable electric drill is used for deep holes of very small diameter, start with a short drill and drill as deep as it will go. Then mount a longer drill of the same diameter, and, if necessary, change again to a still longer drill. The first drill, being short, is not likely to buckle, and the succeeding drills are well supported by the hole already drilled. Broken drills can be reclaimed to make the short ones.—JOHN E. HYLER.

HOLDER FOR MACHINING BUSHINGS

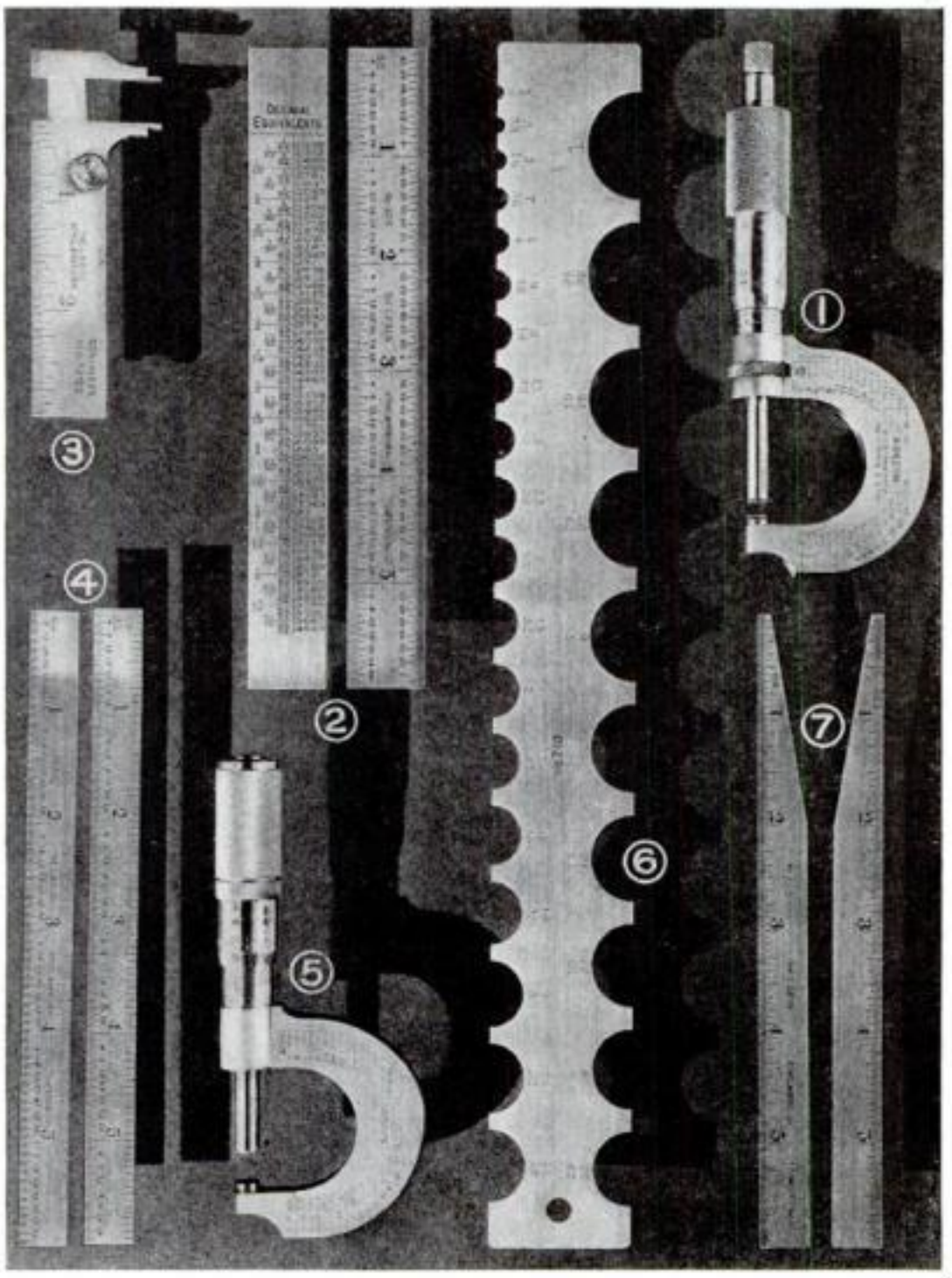
BUSHINGS are often held in the jaws of a chuck while being turned or bored, but they are very likely to be warped out of shape, especially if of bronze. Where only a few are needed, it is, of course, impractical to make any special device for holding them, but for machining twenty or more it pays to prepare a split ring to hold them, as illustrated at *D*. Suppose 100 bronze bushings are to be machined all over as shown at *A*. First grip each bushing in the universal chuck and turn and face the collars accurately, because the collars are later to be held in the split ring. Then pick out from the scrap heap a cast-iron ring, approximately 4 in. in diameter and 1 in. long. Chuck this and turn to 3½ in. diameter, leaving a ¼-in. shoulder with a small recess as shown at *B*. Rough-bore to 2¼ in. Now remove the universal chuck and put on the independent four-jawed chuck. Grip the ring by the turned portions and true up until the bored hole is running dead true. Face the ring and bore a scant ½ in. deep and 2⅞ plus .002 in. in diameter to receive the bushing collars. This leaves a shoulder against which the bushing collars are pressed. Mark one chuck jaw and the face of the ring in line as shown at *C*. Split the ring with a hack saw close to the marked jaw and file all burrs carefully from the saw cut. Loosen the marked jaw slightly, place the first bushing, tighten the jaw, and proceed to machine the work in the regulation manner. Loosen only the marked jaw to put in and take out work. A sectional view of the ring with the bushing and chuck is shown at *D*. The whole idea is to insure uniform pressure on the bushing collar instead of in spots as when the chuck jaws alone are used. Besides, the ring insures the perfect alignment of each bushing.—A. S.



A typical bushing *(A)*; how the split ring is shouldered *(B)* and marked *(C)*; and the final set-up *(D)*

New . . . Ingenious Starrett Tools

There are seven of them . . . *and every one hits the bullseye.* Look them over . . . you will find that there's a genuine need for each one. Like all the Starrett Tools you already know, they are designed to make your work easier or more accurate . . . *or both.*



1

Micrometer No. 230-X—See those dark facings on the anvil and spindle? They are Carboloy, the new alloy next in hardness to the diamond . . . so hard that ordinary grinding wheels can't touch it! No. 230-X is a lifetime micrometer, even on severest service.

2

Steel Rule No. 305—On one side quick-reading 32nd and 64th graduations; on the other, a complete table of decimal equivalents. A time-saving combination. Price: 90c.

3

Pocket Slide Caliper No. 1025—Like the popular Starrett Caliper No. 425, but made of the finest *Stainless* Steel. Always bright; cannot rust or lose its finish. Price: $6.75

4

Flexible Steel Rule No. 327—Quick-reading 32nd and 64th graduations and regular 16th graduations, all starting from one end. No turning end-for-end—no upside-down readings. Finest spring-tempered steel. Price 90c.

5

Micrometer No. 203-F—Friction stop is placed right in the thimble, making it easier to use the stop when the tool is held in one hand. An ideal mike for rapid inspection work, etc. Price: $8.50

6

Ball or Radius Gage No. 710—A new type of gage for die sinkers, designed to check roughing and finished cutters. Radii in steps of 32nds, from 1/8 to 1". Price: $2.25

7

Steel Rule No. 328—A flexible rule graduated in 32nds and 64ths, and tapered for easy measurements in holes, slots, etc. Price: 90c.

Coupon will bring complete descriptions

THE L. S. STARRETT CO., ATHOL, MASS.
Gentlemen: Please send me complete descriptions of the new Starrett Tools; also the Starrett Catalog No. 25 W.

Name .....
Address .....
City ..... State .....

5237

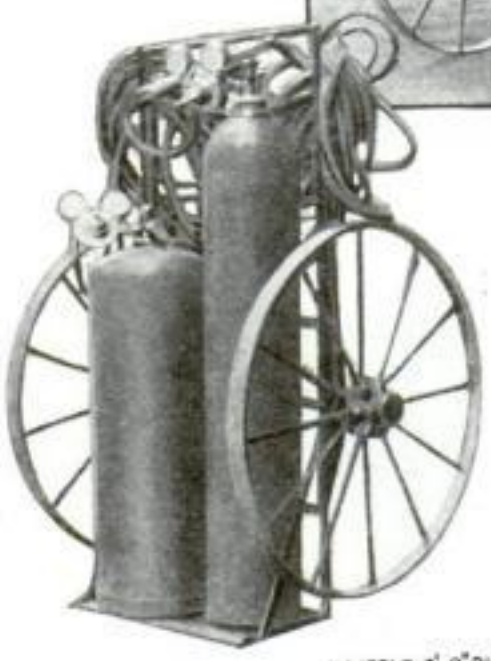
This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS . . . See page 8

BIG-WHEELED CART FOR WELDING TANKS

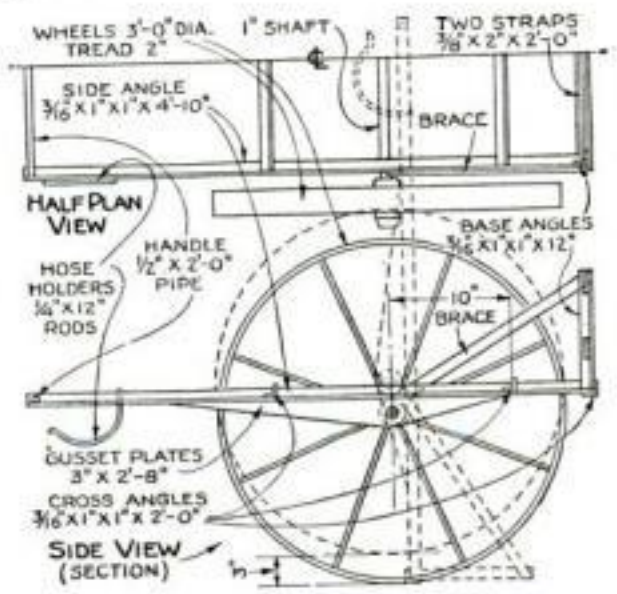
Because of the large size of the wheels, this carrier for welding tanks is especially convenient, besides being light and strong. The wheels are 36 in. in diameter, have a 2-in. tread, and are carried on a 1-in. axle. The large diameter serves a two-fold purpose: First, the center of gravity is kept high, so that when the tanks are horizontal the carriage is in almost perfect balance, and a minimum of exertion is required to upend the tanks for use. Second, any obstruction on the shop floor is more easily surmounted by the large wheels when the tanks are being moved from one welding job to another. These particular wheels were salvaged from an old concrete cart, but any wheels of large diameter would be satisfactory if it is remembered, in centering the axle, that the treads of the wheels should be about 3 in. from the ground when the tanks are upended for use. The center should be located before the gusset plates are attached. Then, when the hose is placed on the hooks, the whole carriage is in excellent balance. As the tanks are extremely heavy, this feature is most desirable. The stock required is as follows: Frame—2 angles 3/16 by 1 by 1 by 58 in.; 3 angles 3/16 by 1 by 1 by 24 in.; 1 pipe for handle ½ by 24 in.; 2 gusset plates 3 by 32 in., punched for shaft 10 in. from end. Base—2 angles 3/16 by 1 by 1 by 12 in.; 2 straps ⅜ by 2 by 24 in.; 2 braces ¼ by 1 by 21 in.; 2 hose holders made by bending ¼ by 12 in. rods to a hook shape; 1 pair wheels 36 in. diameter, 2-in. face, and with a 1-in. shaft of the proper length.

The frame is welded up and the base attached. It is then upended, and wheels centered, and the center moved back 3 in. when the gusset plate is attached to the frame.—H. Caldwell.

If the wheels are carefully placed, the cart will be in good balance when in the horizontal position. In the illustration above, the cart is practically in equilibrium



The cart in position at the job. The wheels should be attached so the treads are 3 in. from the ground when the cart is upended for use



Drawings showing the construction of the cart. The frame is assembled by welding

Old Bill *Says*..

The proper way to mount a diamond is to have the shaft set in the base block or holder at a slight angle. When dressing a wheel, set the base block so that the shaft is inclined in the same direction as the travel of the wheel.

When it is necessary to give a hole a flat bottom, look around for an old drill before you square up the end of a good one.

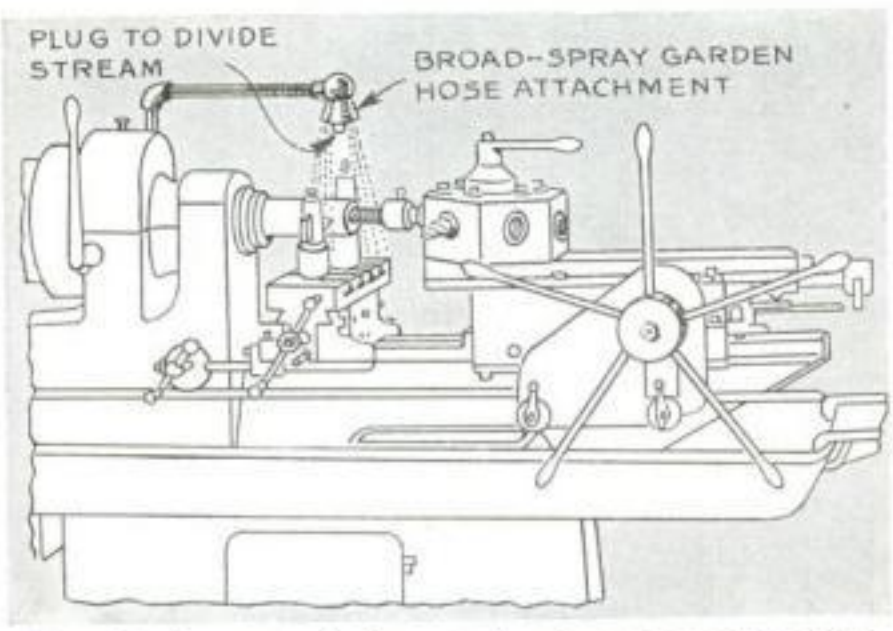
To spring a draw-in chuck out of true in order to accommodate odd sizes of stock is extremely poor practice.

As a safety measure before using a tool-post grinder, see that it is not overspeeded for the diameter of the wheel you intend to use.

A good machinist takes care never to damage the center hole of any tool with a taper shank.

SPRAYING OIL ON SCREW MACHINE WORK

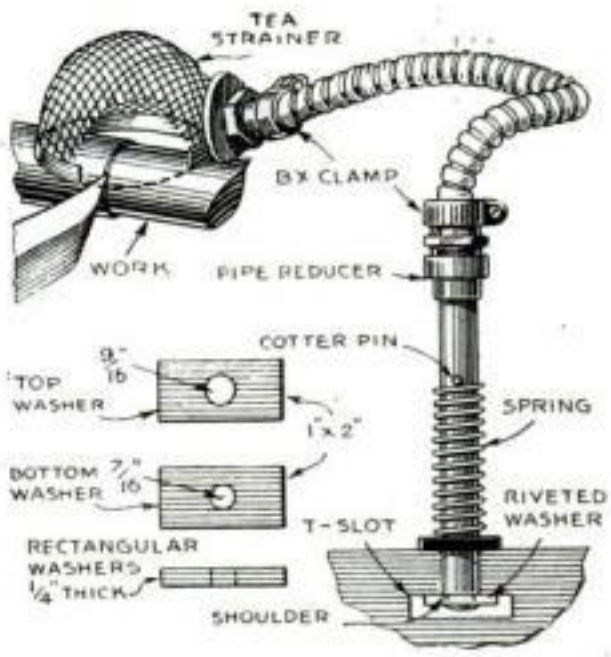
It is sometimes a problem to feed the oil on very rapid work being turned out by screw machines and automatics. This is especially true where several operations are being performed at once. Recently I utilized a broad-spray garden hose attachment while using the double tool post setup with box tool and die. The spraying attachment was plugged in the center with a small piece of brass to divide the stream. —Allan B. Shaw.



How a broad-spray garden hose attachment can be used when it is necessary to supply several automatic lathe operations with oil

LATHE CHIP GUARD MADE FROM TEA STRAINER

An efficient protector from flying chips can be made by the method illustrated in the accompanying drawing from an ordinary tea strainer and such odds and ends as may be found lying around almost any shop. In addition to the few parts to be made and the tea strainer, it is necessary to have ½ by ¼ in. pipe bushing, two BX clamp bushings, a suitable length of BX, a spring 3 in. long, and a cotter pin. The protector can be moved easily on and off the work, yet it is a substantial guard against being burned or otherwise seriously injured by stray chips. In use, set the guard well over the point of the tool.—Thomas E. McGaughey.

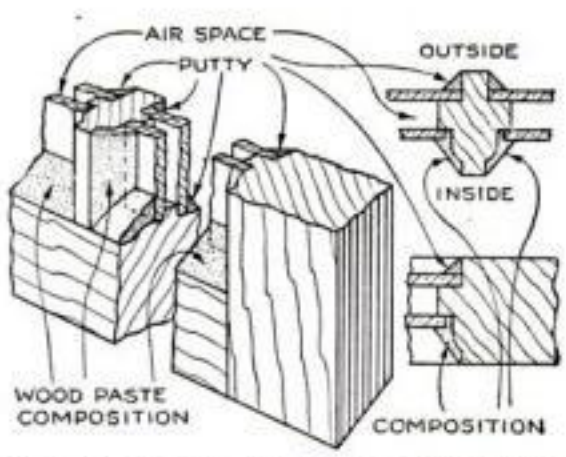


BRONZE POWDER BRINGS OUT GRAIN OF OAK

IF YOU are tired of the various conventional finishes for oak, chestnut, or any other open-grained wood, try the following process: First, sandpaper the surface and dust thoroughly to clean the pores. Then apply, preferably with a spray gun, one or more well-thinned coats of lacquer of an appropriate color. When this is dry, go over it lightly with worn or very fine sandpaper, and dust again. Mix a quantity of bronze powder with turpentine and, using a rag or tuft of waste, rub this mixture well into the pores of the wood, but take care that none adheres to the other parts of the surface. After twenty-four hours, apply a coat or two of furniture wax.—ERVIN WALTERS.

EXTRA GLASS IMPROVES COLD NORTH WINDOWS

THE cold air from frozen windowpanes on the north side of a house can be kept away by putting an extra pane of glass on the inside of the sash as shown, provided there is a sufficient shoulder for the glass to rest against. The only cost is for the glass and a good grade of composition wood paste which is used instead of putty. The plastic material can be had



The extra lights of glass are fitted on the inside of the sash and held with wood paste

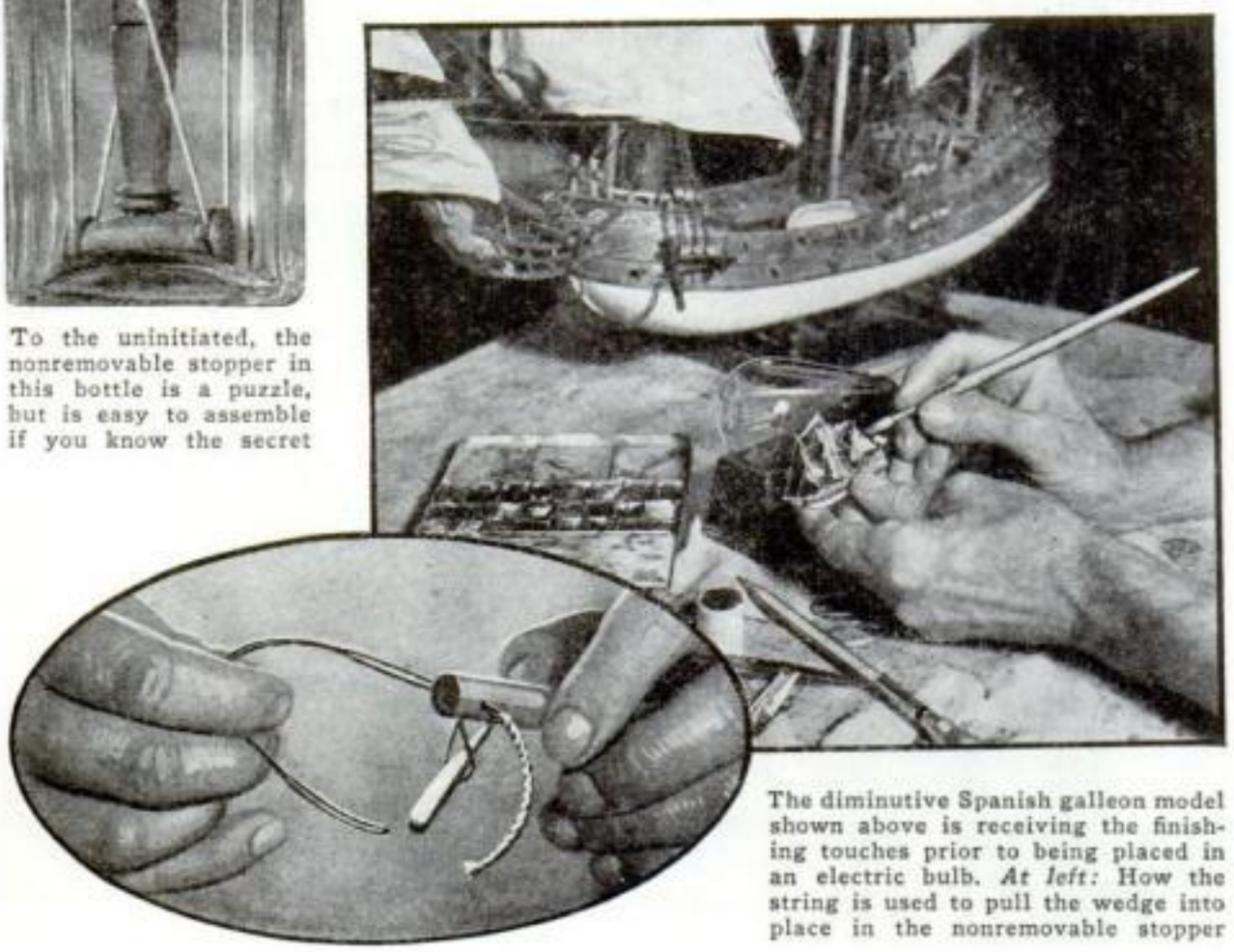
in different colors and also can be painted. If by chance there is a plant near by which does photo-engraving, the glass can be bought at very low cost in sizes 8 by 10, 10 by 12, 11 by 14, and 14 by 17; and, of course, it may be easily cut to the exact size wanted. Have the glass 1/16 in. smaller than the opening it is to fit in. Apply the wood composition about ⅛ in. thick and work fast, as it dries very quickly. Be sure the glass is clean before putting it in place.—JOHN J. DE VINK.

A MYSTIFYING Bottle Stopper

and other hints for ship model makers

By CAPT. E. ARMITAGE MCCANN

To the uninitiated, the nonremovable stopper in this bottle is a puzzle, but is easy to assemble if you know the secret



The diminutive Spanish galleon model shown above is receiving the finishing touches prior to being placed in an electric bulb. *At left:* How the string is used to pull the wedge into place in the nonremovable stopper

SO MANY readers entered our ship-model-in-a-bottle contest last year and so much enthusiastic correspondence has since been received on this curious phase of model making that it will be of general interest to give some additional notes on two points upon which little has ever been published—the construction of trick stoppers and methods of putting sails on ships in bottles.

If you wish to build a ship model in a bottle but missed the previous articles (P.S.M., Aug. '30, p. 71; and Feb. '31, p. 112), all you need do is obtain our Blueprints Nos. 121 and 122 (see page 107), which give complete information for building a bottle model of a clipper ship without sails.

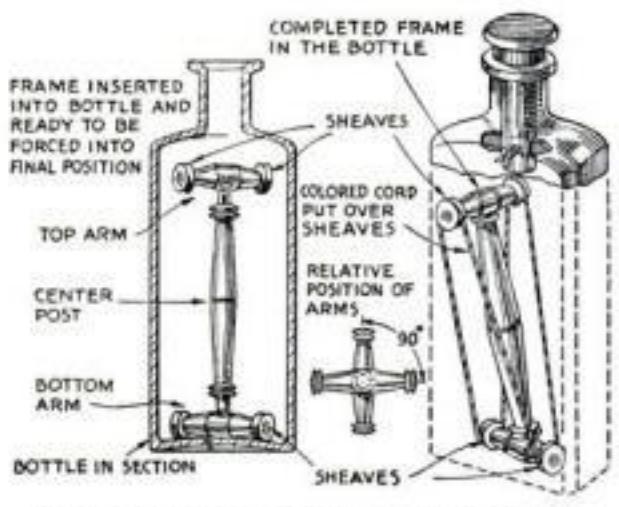
To take up first the making of a nonremovable stopper, one of the best methods has been worked out by LeRoy Van Tassel, of Genoa, Ohio, who made the puzzle shown in the uppermost photograph. His letter explaining the trick is so clear that I shall quote it:

The main feature is a wooden plug or stopper with a wooden pin passing through the inner end and a short piece of string running through both plug and pin. This looks like an impossible construction and is quite mystifying. It is an ideal way of plugging a bottle with a ship in it. The frame inside the bottle shown is there merely to make the puzzle look more complicated.

Get a clear bottle of the shape shown or a round one which has a similar shoulder at almost right angles to the neck. Turn a wooden plug about 1/16 in. smaller than the opening and about ¾ in. longer than the neck. Make the pin wedge shaped and also a tapering in width. Cut a hole for it in the plug so that it will slip in without hitting the bottle. It should fit the hole in the plug as accurately as possible. Put the pin in the hole and drill a small hole—not more than 1/16 in.—through both.

Twist a short piece of string quite tightly the way it was originally spun, catch it in the middle, bring the two ends together, and let it twist on itself. Measure from the loop end about twice the diameter of the plug, tie a knot, and cut the string. It should be large enough to fit the small hole fairly tight. Now take a piece of stout cord such as braided fishline and thread it through the loop of the other cord as you would thread a needle. Draw the ends even and slip them through the small hole in the plug and pin, but do not pull the short string through. Next push out the pin and put pin and plug in the bottle. Lay the bottle on its side with the larger end of the hole in the plug down. If you have made the pin correctly, it will hang with the point up. Slowly pull the string and shake the bottle, drawing the pin into the hole. When the pin is in place, pull the short string through as far as the knot will allow and saw the line back and forth until you have cut through the loop. Pull the line out, leaving the short string extending through plug and pin to mystify all observers.

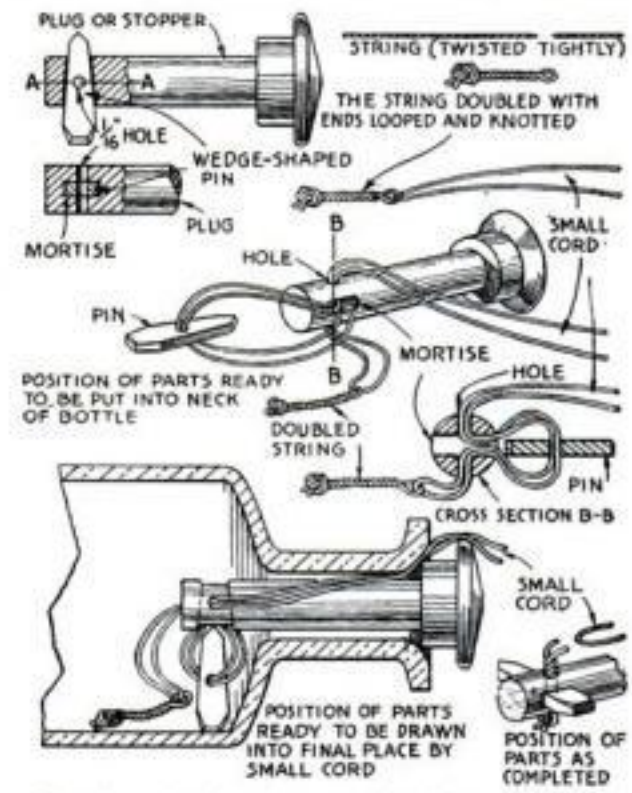
Should you also wish to make a frame like the one shown, turn the three pieces, drop the bottom crosspiece in the bottle, shake around until the mortise faces up, loop a piece of magnet wire around the top end of the upright piece, let it down in the bottle, and holding the tenon over the mortise, force it in with a stick. Tie a string to one end of the top crosspiece and drop it into the bottle. Now cut one end of the stick to go into the mortise far enough to lift the piece but not far enough to keep the tenon in the upright member from entering the other side. Hold the upright in position, put the crosspiece over it, and press it down. Wrap the string around in the grooves with a piece of wire and tie it with a slip knot. All this is easier to do than to describe.



If you wish to construct the entire puzzle, this is how the frame should be inserted

To return now to the ship models, our original article said little about sails. Although the first and third prize winning ships in the contest had sails, it was not on that account they were awarded the prizes. Incidentally, Harold T. Bodkin, of Chicago, Ill., the third prize winner, has since had two motion picture companies take moving pictures of his ship models; one of the leading photographic agencies made still pictures to release to the members of its syndicate; and one of the largest Chicago theaters made a one-man display of his models in the foyer for three weeks. Four of the five ships in this display either were constructed from POPULAR SCIENCE MONTHLY plans or were adaptations of such plans.

Mr. Bodkin makes his sails of tough tissue paper. When the model is completed, he cuts these to fit the yards with some slack in the depth to allow for the belly. He glues them to the yards, and the



Sketches showing how the locking wedge can be drawn into place in the plug with a cord

fore and aft sails to the stays. These sails fold up easily for insertion into the bottle with the ship. Later on when the putty sea has hardened, he makes a hook of steel wire long enough to reach the model from the outside. The hook end is about 1 in. long. He dips the hook in boiling water and, starting with the mizzen sails, quickly inserts it between the mast and sail and pulls gently so as to iron a belly in the sail, using an up and down motion. He does about two sails at a time. Then he heats the hook until he can just touch it without burning himself and repeats the ironing process on the dampened sails, thus shaping them permanently to the bellied form desired.

CHARLES V. NIELSEN, of Hasbrouck Heights, N. J., the first prize winner, who makes the finest ship models in bottles that it has ever been my pleasure to see and is therefore able to sell them readily to discriminating collectors, uses a thin but high-grade window shade cloth for sails. On this material he draws fine lines to represent the sail cloths, and he rolls the sails gently between his fingers to get the belly. He uses liquid glue, which has been allowed to stand open until half dry, for attaching the sails.

Some model makers cut the sails from thin, stiff paper before inserting the ship; then when the model is fixed in the bottle, glue them along where they are to lie on the yards and insert them one at a time, fixing them in position with wires. Others carve the sails from wood and insert them similarly.

Some readers have been puzzled as to the best method of inserting the colored putty sea. Roll it into a thin "sausage," lay this on a strip of paper so as not to soil the neck of the bottle, and, holding the putty in the bottle with a narrow wooden paddle, withdraw the paper. Then spread the putty in position.

Not all ships are put in quart bottles. Some are made to stand upright in squat bottles, others to fill square bottles and large or small flasks. One illustration at the beginning of this article shows a tiny Spanish galleon with painted sails of cigarette paper receiving its final touches before being inserted into an electric light bulb. A flashlight lamp is set in the bulb where the lamp filament is removed and is wired to batteries in the wooden base so that it will light up the model when a small switch is thrown.

ELECTRIC BULB REMOVER FOR HIGH FIXTURES

THE home owner who has to replace bulbs in out-of-reach electric fixtures placed on the ceilings of high-walled rooms will welcome this simple bulb remover. Obtain a long, stout pole of the type used for broom and mop handles and on one end fasten a rubber pocket made from half of an old automobile horn bulb or from the rubber head on a plumber's force pump. To use the bulb remover, raise the pocket to the bulb, apply sufficient pressure to cause some friction between the pocket and bulb, and turn the pole to the left. Bulbs may be replaced by a reversal of the same process.—L. B. ROBBINS.

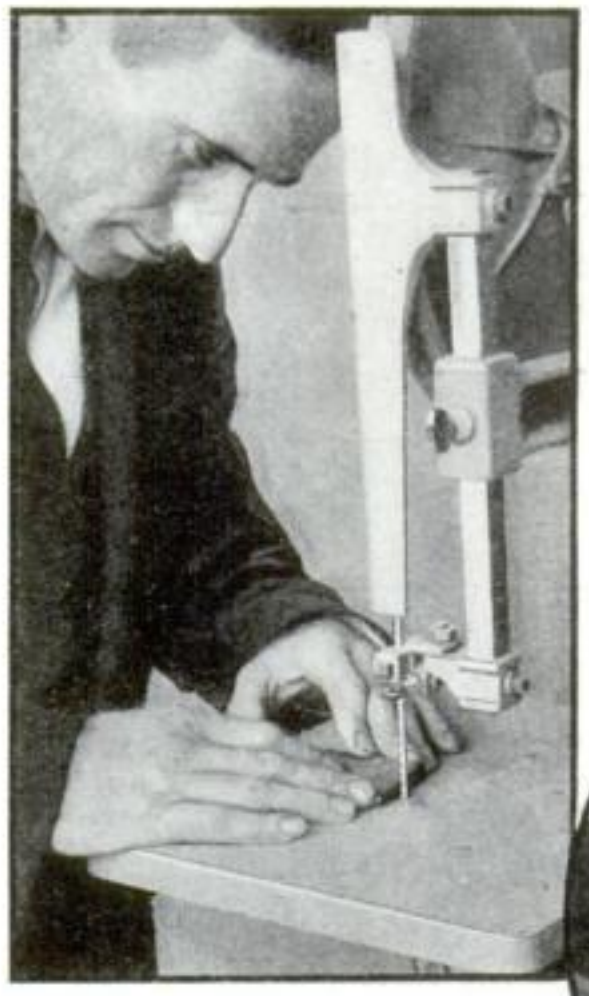
Sharpening Small Band Saws

By Charles A. King

HOME craftsmen as a rule prefer to do their own saw filing, but often hesitate to undertake what appears to be as difficult a task as sharpening a band saw blade. It is, indeed, an awkward job to attempt to file a band saw in an ordinary hand saw vise, yet the work is comparatively easy if a special filing jig is made as shown in the accompanying illustrations.

The base is a piece of pine 2 by 8 by 48 in., dressed on four sides. Make two wheels *A* of pine or any easily worked wood, and two spindles *B* of maple or other hard wood; one wheel base *C* of pine, ¾ by 2 by 6 in.; and another piece for the sliding base *D*, ¾ by 2 by 30 in., by which the wheels may be adjusted to different lengths of saws; also four pieces of pine ¾ by 2 by 2 in. for the guides *E*, and two top pieces C^1, ¾ by 2 by 6 in. Fasten spindles *B* to pieces *C* and *D* with screws as shown, and fit piece *D* so it will slide freely. Make the cam *F* of hard wood and fasten loosely to the bed with a 2-in. No. 12 screw to hold slide *D* at any point to suit the length of the band saw. Place the wheels *A* on the spindles *B* without fastening them.

The face vise jaw *G* and the back jaw *H* may be of any hard wood; be sure the inside surface and the top edge of each are straight. Bevel the top edge of each jaw as shown, glue smoothly a piece of tough wrapping paper about 3/16 in. wide inside the top edge of each jaw as at *J*, which will make the iron jaw linings G^1 and H^1 grip the saw tightly just below the teeth and hold it firmly with even pressure.



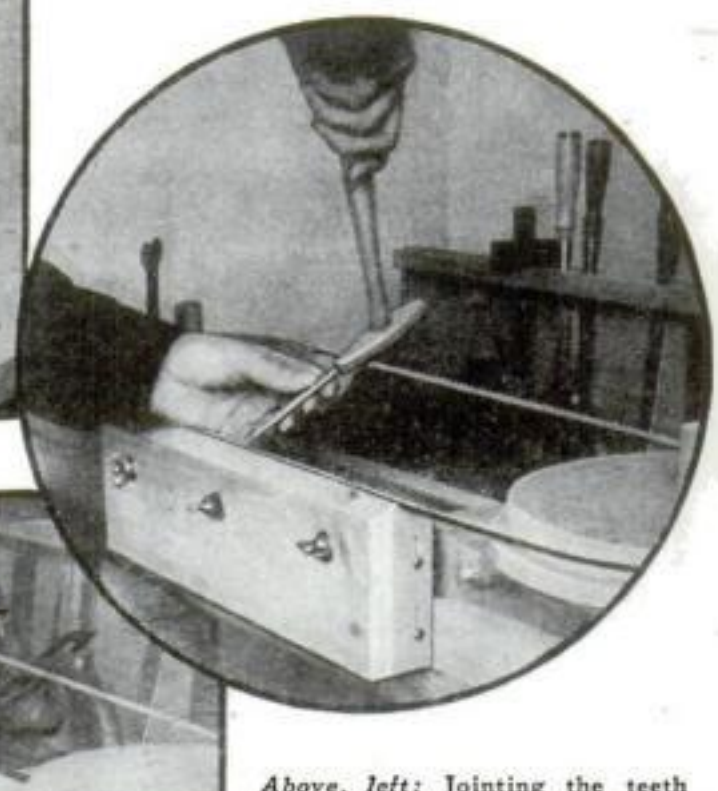
To make the iron jaws G^1 and H^1, get out two straight pieces of strap iron or steel about 3/32 in. thick and 1 in. wide. Drill and countersink the holes marked *2* so that ¾-in. No. 10 screws will sink a little below the surface in both, but the holes in G^1 should be slotted as indicated because that jaw will be raised about 1/16 in. in setting a saw and lowered for filing. Bevel the upper inside edge of G^1 with a flat file down about 1/16 in., making the angle shown at G^2 to form the setting anvil, the use of which will be discussed later.

Join the bottom edges of the two jaws with 1¾-in. hinges at *L*, being sure that the top edges of the jaws coincide perfectly. Any small defect may be remedied by careful filing. Bore three holes *Y* through both jaws to receive 5/16 in. by 2½ in. wing-nut carriage bolts and washers. Fasten the back jaw to the edge of the bed with 1¾-in. No. 10 screws as indicated at *M*.

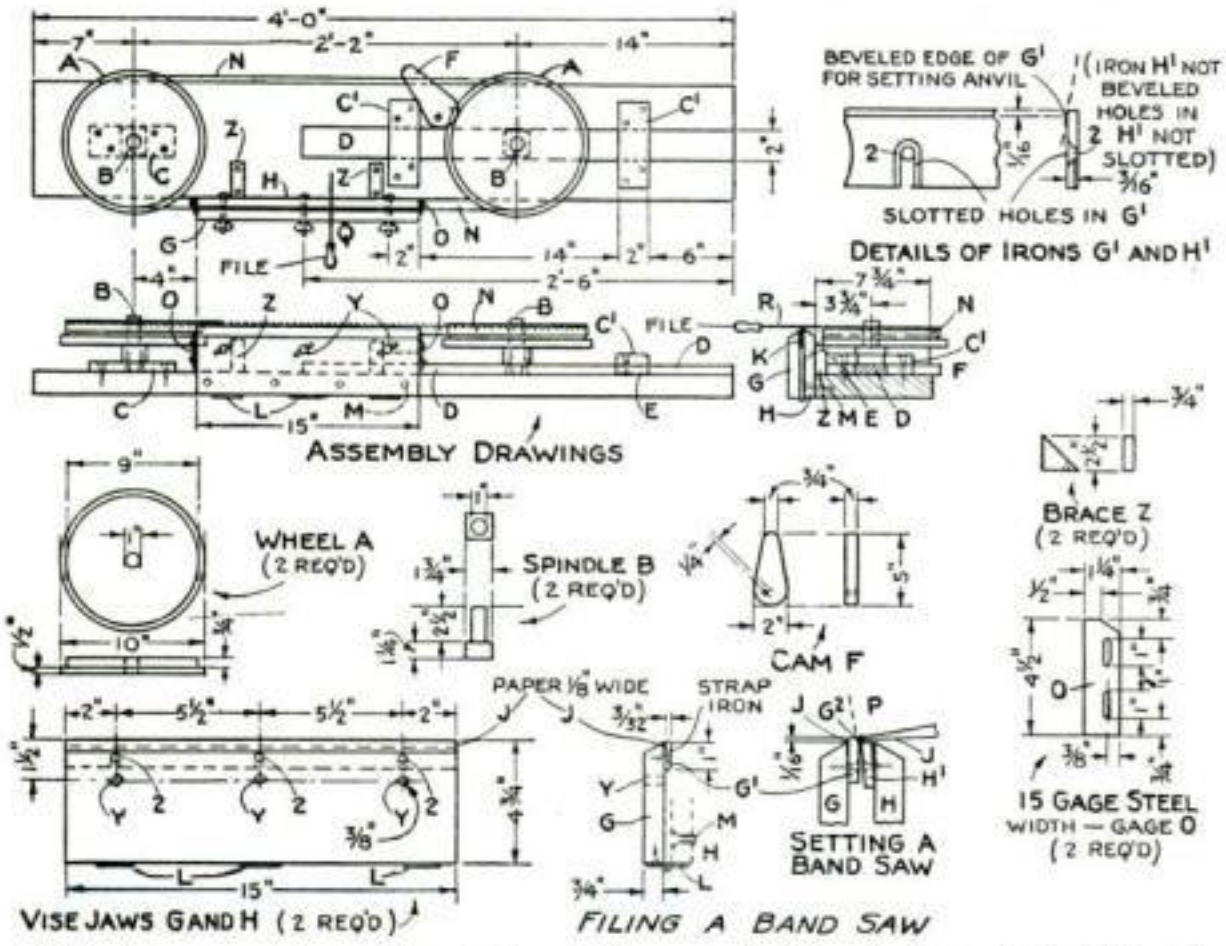
If the work has been done accurately, the top of the vise jaws will line up about ¼ in. below the top of the wheels *A*, and a band saw *N* placed around the wheels will drop between the vise jaws. To insure that the band saw rests in the vise as it should, a metal width-gage *O* should be adjusted in height by two 1¼ in. No. 8 roundhead screws driven through the slots of the gage into each end of the back vise jaw (see assembly views).

Make two triangular braces *Z* and fasten with glue and screws. Place the bed with the assembled details upon the bench top and hold firmly with hand screws. It may be desirable to raise the bed to bring the top of the vise from 43 to 45 in. from the floor by placing blocks under it; this will be a more convenient height to file a saw while standing up, as it will require the least amount of bending.

To sharpen a band saw, adjust the



Above, left: Jointing the teeth with the end of a slip stone. *Above:* A square-ended nail set can be used in the manner illustrated to obtain the proper set. *Left:* The file is held horizontal and square across the blade



While pine or any other easily worked wood will serve for the main base, wheels, slide, and guides, a hard wood such as maple should be used for the wheel spindles, cam, and vise jaws

wheels and guides of the machine so the saw runs true when free. Set the guides to this position, start the machine, and move a piece of oilstone (the end of a slip stone will do) from right to left on the table and just touching the moving saw *lightly*. This jointing of a band saw should not be carried as far as in jointing a hand saw, but an occasional long tooth should be cut back so that its length is equal to the average.

THE next step is setting the saw. The writer has never owned an ordinary handsaw set that would efficiently set a band saw narrower than ¼ in., and a set of the type that will set any saw is so expensive that amateurs rarely have one. It is therefore quite justifiable to take ¼-in. or narrower saws to a mill for setting, especially as the saw may be filed several times after one jointing and setting. However, an alternative exists—to set the saw by a method similar to that used before automatic sets were invented. Raise iron jaw G^1 until 1/16 in. or less above the wood and set the screws in the slotted holes *2* to hold the jaw firmly in place. Put the saw, just as it was taken from the machine, on wheels *A* and between the jaws. Make the top of the teeth for the entire length of the vise flush with the top of the iron jaw G^1 by pressing the saw down with a piece of hard wood held level and by tightening set screw *V* to hold the saw rigidly.

With a square ended nail set and a light hammer, proceed as indicated at *P* in the detail drawing marked "setting a band saw." Hold the set nearly horizontal and do all the teeth upon the anvil side for the length of the vise with one light tap of the hammer on each tooth. Tie a piece of string around the saw to mark the beginning tooth, move the saw along and continue. When the teeth have been set all around, turn the saw over to bring the teeth of the other side against the anvil and pointing the other way. Be sure that the nail set is held at a uniform angle throughout and that each tap of the hammer delivers as nearly as possible the same impact to each saw tooth, so that each tooth will be bent the same amount.

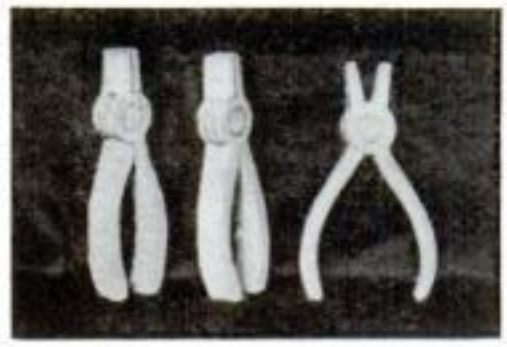
THE saw is now in the correct position for filing; that is, the teeth point toward the right. Drop the iron jaw G^1 until it is flush with its mate. The saw should be only high enough to prevent filing the vise. Use a 6-in. slim taper file or a band saw taper file, either smooth or double cut. The file should be carried squarely across the saw as at *Q* and level as at *R*. File all teeth from the same side; begin at the right-hand end of the vise so that the top of each tooth will be filed last, which will give a better cutting edge.

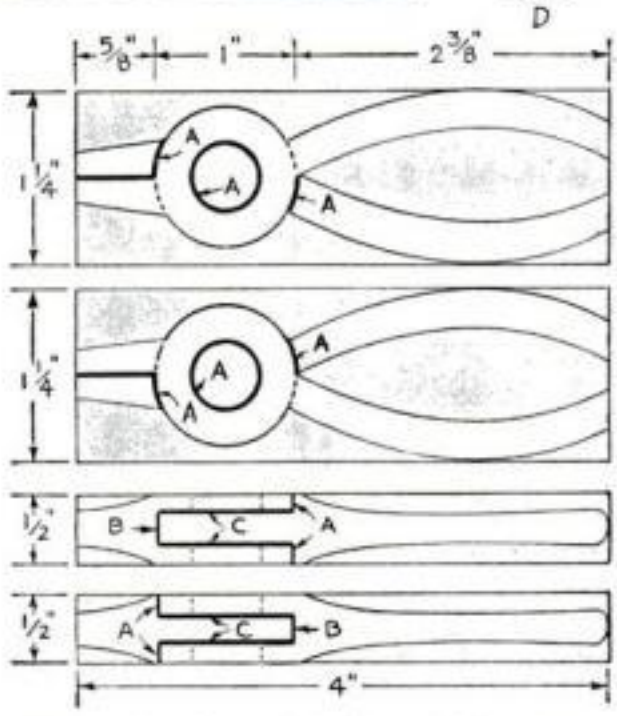
Many filers prefer to file the teeth from opposite sides, carrying the file at an angle as in filing hand saws, but the method just described is used quite as often and gives satisfactory results, especially in sawing with the grain—an important advantage. File until all points which catch the light have been sharpened. Usually a light touch upon the top of one tooth and on the face of the one behind it will be enough unless the saw is in very bad shape.

NEW WAY TO WHITTLE WOODEN PLIERS

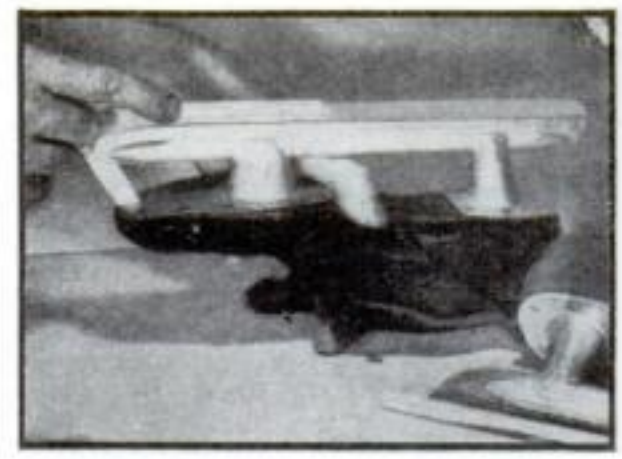
UNLIKE most wooden pliers which whittlers so often make to display their skill, the pliers illustrated have a type of joint that closely resembles that used on regular metal pliers. Obtain several basswood blocks ½ by 1¼ by 4 in. The reason basswood is desirable is because inner cuts can be made in it without much danger that the wood will split beyond the blade of the knife. Draw the shape of the pliers accurately on paper, and cut out the pattern so that it can be used in transferring the outline to the top of one of the blocks. Trim the blank to the outline with knife or saw, but leave the handles without further whittling until the joint is made.

The cuts marked *A* on the top and bottom views are incised until they meet the cuts marked *C* on the edge views. Cuts *C* penetrate into the joint all the way around to the distance indicated by the shaded part of drawing *D*. The two cuts *B* follow the line of the circle and extend to the center line between jaws and handles. Make all cuts sufficiently deep and then split apart the jaws. If the jaws stick or bind, when all cuts have been made, go over the cuts once more until they are thoroughly loosened. The jaws and handles then should be whittled to their finished shapes.—W. L. FAUROT.





Three pairs of whittled pliers and drawings showing the order in which the cuts are made



HOLLOW CURTAIN RODS GUARD SKATE BLADES

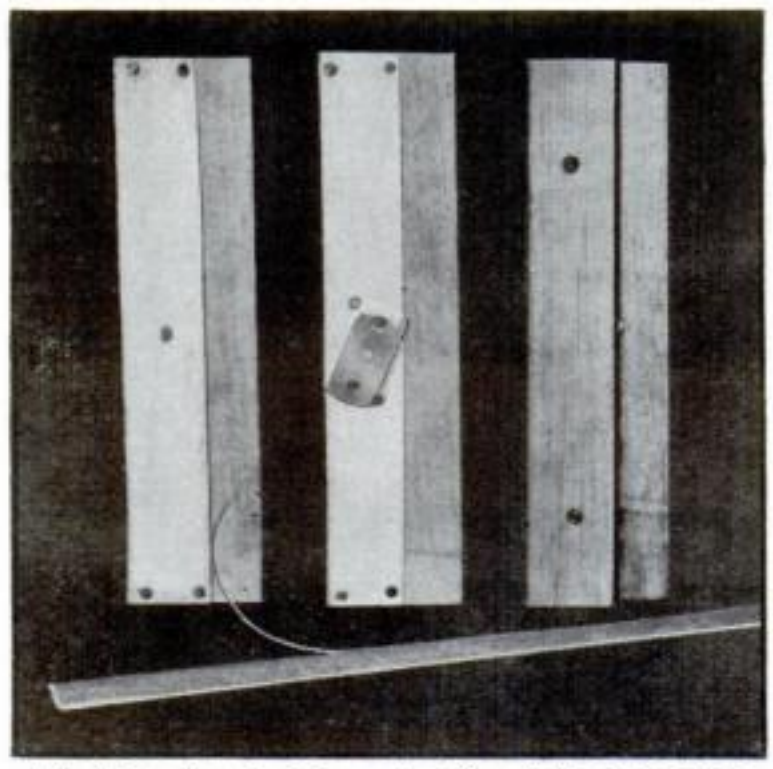
WHEN skates are carried slung over the arm or in a bag, the runners can be protected from becoming nicked by the use of guards made from hollow brass curtain rod stock. The curtain rod, which usually comes with a split extending the length of it, is pushed over the steel skate blade as shown. Oiled tape can be placed inside the tubing, if desired, to prevent rust forming.—R. M.

TYING A USEFUL LOOP THAT NEVER SLIPS

WHETHER or not you intend to rope wild horses or steers, you will find the lariat loop a useful knot to know. It is easily tied, as a study of the accompanying illustration will reveal. The loop, once formed, retains its size and shape; and the greater the strain thrown on it, the more securely it holds. You might find it useful in making a slipknot for holding a bundle of molding or other objects, simply by running the free end through the loop. If you ever have to lower a person over a precipice or out a window in an emergency, tie the knot with a large loop—big enough to pass beneath the armpits—and the loop will not tighten. To tie a boat line to a post in such a way that it will not become so tight you cannot remove it easily, try the lariat loop. With a little ingenuity you can apply the knot to dozens of other similar tasks. If you want to make sure that the end does not slip out, tie a simple over-hand knot in it.—W. E. B.

IMPROVED CUTTER FOR BALSA STRIPS

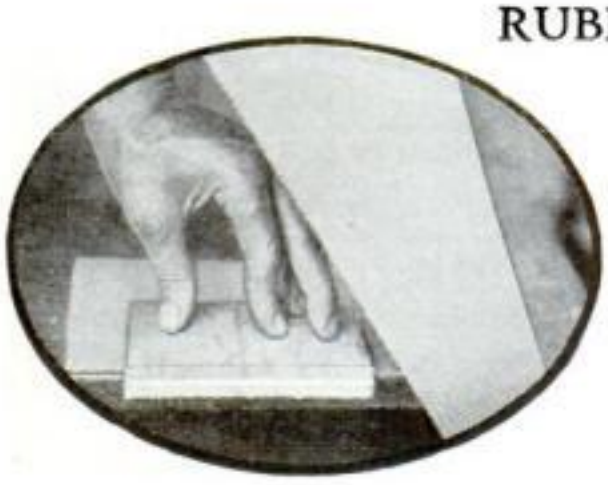
WHEN airplane model makers buy balsa wood strips, they pay for the cutting as well as the wood. It is considerably cheaper to buy balsa in large sheets and cut it into strips with the device illustrated, which is an improvement over most homemade cutters. This is a ¼ by 2½ by 8 in. block of wood to which is nailed another piece of the same thickness as the balsa strips are to be. The second piece should be as long as the first but only about half as wide. A razor blade is now nailed in the position indicated, one corner extending about ⅛ in. beyond the edge of the stock. On this is nailed a cover piece the same width and length as the second piece but about ⅜ in. thick. The edge of the ⅜-in. strip serves as a guide for the stock to be cut, which is moved along it and at the same time pressed tightly against the baseboard. Holding the cutter in a vise makes the work easier.—EDWIN T. HAMILTON.



The three steps in the construction of the balsa strip cutter. In use, it can be clamped in the bench vise

Here is a simple knot that can't slip. The harder the pull, the more secure it becomes

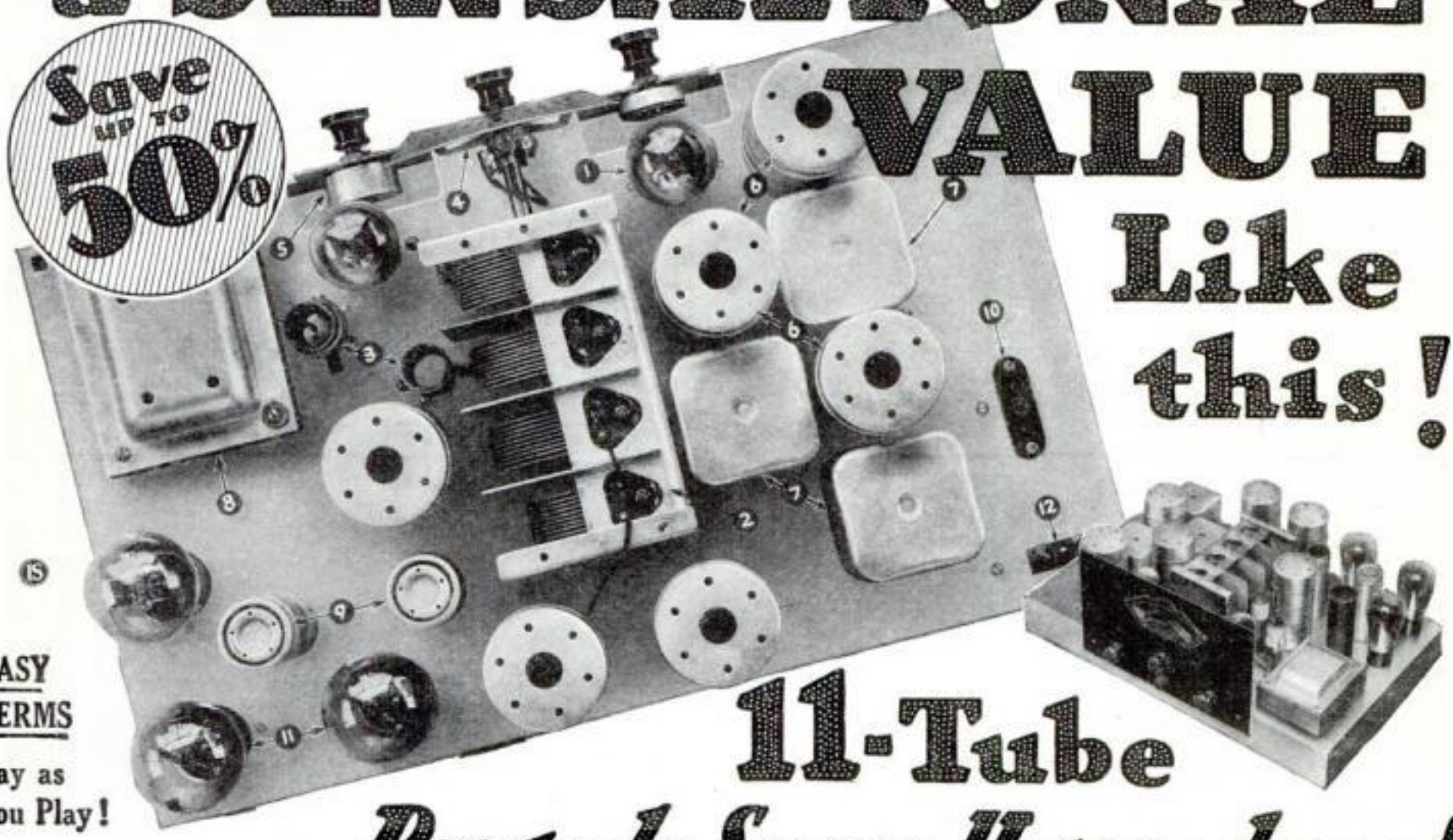
RUBBER MAT AIDS IN SAWING



WHEN it is necessary to saw short, thin blocks of wood, they can be held easily on top of a sawhorse or bench if a piece of old inner tube or other thin rubber is laid under them as shown at the left. The fingers then can keep the blocks from shifting under the saw with but little effort, and there is far less danger that either saw or work will slip. Then, too, the springiness of the rubber will absorb the vibrations usually caused by the teeth when starting a cut.—F. BENTLEY, JR.

Feb 1932

Never Before a SENSATIONAL VALUE Like this!



EASY TERMS

Pay as You Play!

11-Tube Pentode Super-Heterodyne!

With Real Automatic Volume Control

More value for your money. Better quality. Greater clarity. Amazing selectivity. Perfect control of volume. Great distance range. You get all of these and many more outstanding advantages—plus a *saving of more than 50%*—when you buy this sensational new high-power superhet direct from the Midwest Factory. Furthermore, you are guaranteed absolute satisfaction or your money back, and 30 days' FREE TRIAL in your own home.

only $37.50

COMPLETELY ASSEMBLED

With Specially Matched Large DYNAMIC SPEAKER

30 DAYS FREE TRIAL

Compare These Midwest Features Before You Buy!

You save more than half, and get all these great features as shown by the numbers on the photograph above:

1. Automatic Volume Control
2. Pre-Selector
3. Litz Wound Coils
4. Full-Vision Dial
5. Tone Control
6. Variable-Mu and Screen Grids
7. Two-Stage Balanced I.F.
8. Oversize Power Transformer
9. Electrolytic Condensers
10. Phonograph Jacks
11. Pentodes in Push Pull
12. Built-in Antenna

Compete Line of Consoles

The big FREE catalog illustrates the complete line of gorgeous Midwest Consoles. Deluxe, Highboy and Lowboy models. Mail the coupon now. Compare the sensational Midwest values before you buy.

TERMS as low as $5.00 DOWN

A Host of Other Features

Police short wave arrangement—Great distance range—Better than 10KC selectivity—Built-in extra light socket—Six screen grids—Low current consumption—Auto body steel chassis—Coast to coast reception—every feature anyone could ask for in a radio. The big FREE Midwest catalog gives you all the facts. Just clip and mail the coupon—Now!

Deal Direct with Factory Save Up to 50%

Direct-to-customer selling makes the surprisingly low Midwest prices possible. Know what it means to have one of the latest and most powerful radios on the market—with all the new 1932 improvements in tone, clarity, selectivity—at about half what you would pay in retail stores.

Absolute guarantee of satisfaction protects you and eliminates all risk. And don't forget—you try any set you select for 30 full days, ABSOLUTELY FREE. You must be delighted. Mail coupon for beautiful new FREE catalog and complete details of FREE TRIAL, easy payment plan. You'll be amazed.

MIDWEST RADIO CORP.
Dept. 45 Cincinnati, Ohio

Mail this Coupon for Complete Details and Big FREE Catalog!

Midwest Radio Corp.
Dept. 45,
Cincinnati, Ohio

Without obligation on my part send me your new 1932 catalog, and complete details of your liberal 30-day free trial offer. This is NOT an order.

Name .....

Address .....

Town ..... State .....

☐ Send me SPECIAL USER AGENTS PROPOSITION

USER AGENTS

We pay you BIG MONEY just for showing your radio to friends and neighbors. Easy EXTRA MONEY! Check coupon for details.

METHODS OF MAKING

Curved Front Furniture

It is not hard if you know how to cut the serpentine parts and face them with veneer

By
DAVID WEBSTER

IT MUST be an inferiority complex that prevents home workers from attempting to reproduce some of the beautiful curved-front pieces of furniture they so much admire. Anyone who can build a straight-front chest of drawers will need but a little more patience to construct one with a serpentine front. In handwork, as in nearly everything else, difficulties seldom turn out to be as bad as anticipated.

As our present interest lies chiefly in the curved front, we shall assume that the ends of the case have been glued with dowel joints and the bottom of the ends shaped as shown in the drawings; also that the front rails (with the front edges left straight), the three back rails, and the ten drawer runs are ready, and that all tenons have been cut on the ends of the rails as indicated in the detail of the end joints. The rails and the runs should be fitted carefully in mortises and grooves as shown, and the case set up temporarily. This gives us the exact size of the case and of the drawer openings, and we can go ahead with the drawer fronts.

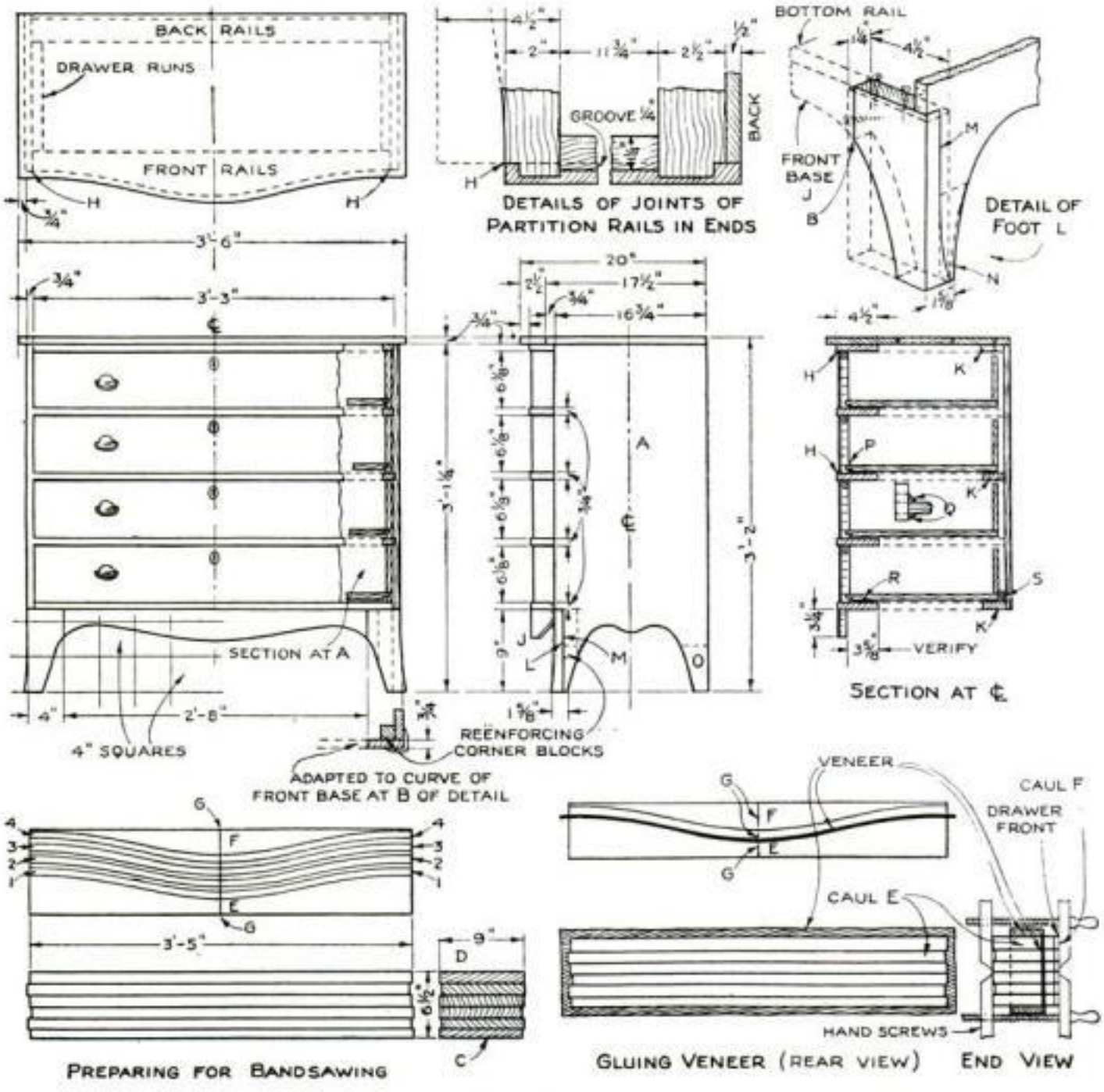
The front cores should be made first. Get out enough pieces of white pine or chestnut from ¾ to 1 3/8 in. thick, 9 in. wide, and 41 in. long to build up a thickness of 6½ in., using face wood for the toppiece. Be sure the wood is thoroughly seasoned, that both surfaces are straight, and that any greasy, old, or discolored surfaces are planed away to the clean wood. Before gluing, see that all necessary appliances are at hand and that at least fifteen hand screws are set and ready for rapid use.

The gluing should be done in a warm room. If cabinetmaker's hot glue is used, heat the pieces, spread the glue with a wide flat brush, and work with the utmost speed both in applying the glue and in using hand screws. Casein glue, which is used cold, does not require so much speed. Hold the block edges up while using the hand screws. Allow the glued-up block to set at least twelve hours in a dry room. Remove the hand screws and plane the bottom side *C* perfectly straight to insure a true bearing on the band saw table.

Make a pattern for the front curves, using thin wood, pasteboard, or zinc, and mark the shape and thickness of each drawer front on the top *D* as shown at *1, 2, 3, 4,* leaving about ½ in. between them. The waste pieces *E* and *F* should be left entire and without saw cuts as shown, for they have an important use later. The band saw must cut smoothly, and each cut must be square with the bottom surface *C;* final results depend largely upon the accuracy with which the sawing is done.

The face of each drawer front should be smoothed lightly with a circular plane or with a carefully used spokeshave. Be sure

(Continued on page 116)

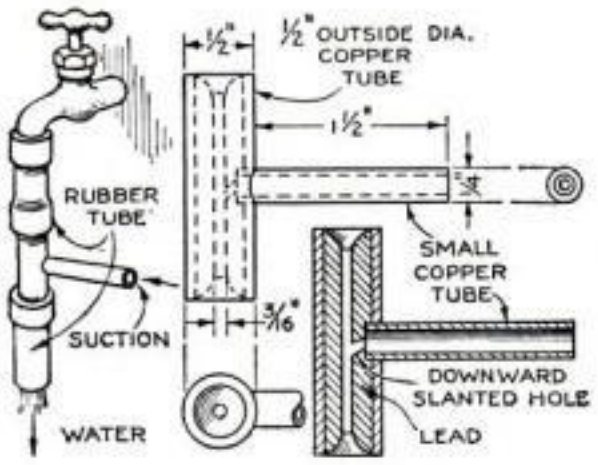


If carefully studied, these drawings will show you the secret of practically everything an amateur cabinetmaker needs to know about building a chest of drawers or other furniture with a serpentine front

AN ASPIRATOR FOR HOME EXPERIMENTS COSTS LITTLE TO MAKE

EVERY amateur experimenter in chemistry and physics at times needs an aspirator, which is a form of suction pump attached to a water faucet. One can be made for a few cents from the following materials: 1 pc. copper tubing ½ in. in external diameter and 1¾ in. long, 1 pc. copper tubing ¼ in. in external diameter and the same length, a sufficient quantity of lead to fill the ½-in. tube, and solder and flux. Although the sizes and lengths of the tubes are specified, it is not absolutely essential that they be followed. Solder may be subsituted for lead in case the latter is not to be had.

The first operation is to tin a spot ½ in. in diameter over the center of the surface of the ½-in. tube. Next the inside surface at both ends is tinned. This tube is then held in a vertical position with



External views of the homemade aspirator and a cross section to show the construction

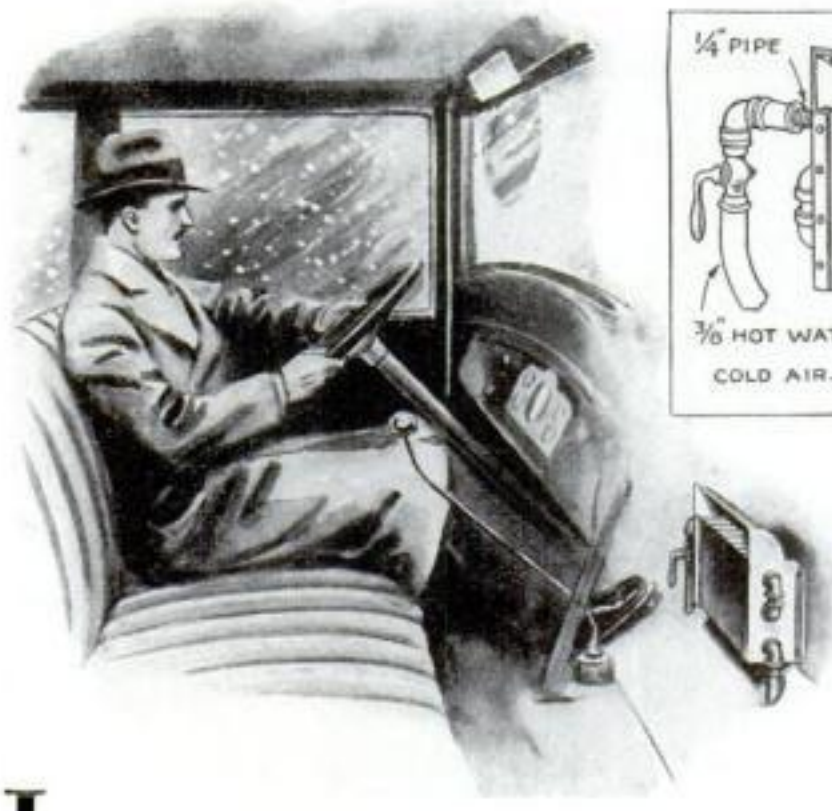
one end against a flat surface, and molten lead (or solder) is poured in up to the top. After the ends have been filed smooth, a 3/16-in. hole is drilled through the center of the lead as shown. The ends of this hole are then beveled with a knife. In the center of the tinned spot first made, a ¼-in. hole is drilled through the copper only. In the center of the lead thus exposed, another 3/16-in. hole is drilled at a slant and in such a way that it will intersect the longitudinal hole (see diagrams above).

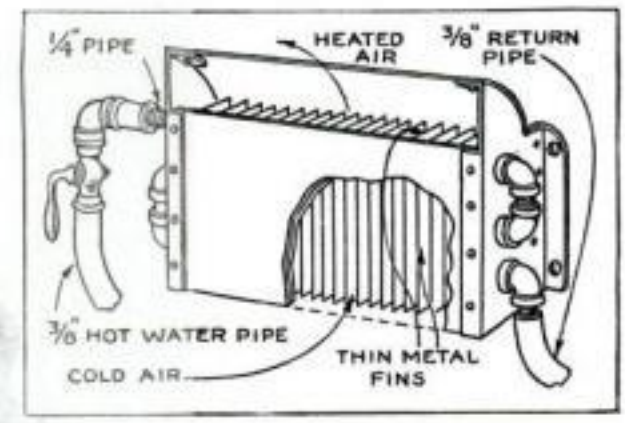
One end of the ¼-in. tube is tinned and then set into the opening already prepared for it, and the joint is soldered as rapidly as possible in order to prevent any lead from melting. To complete the unit, about 6 in. of rubber tubing is wired to each of its ends. In use, it is important that the water go through the unit in the direction of the downward slant of the small side hole which leads from one tube to the other.

When the correct end of the aspirator is connected to a faucet and water is run through, a suction will be produced in the side arm. Best results are obtained when the water issues from the lower tube in a steady stream. This can be brought about by placing a finger over the bottom of the tube for an instant when the water is running. Under these conditions, the aspirator will be found capable of producing a 26-in. vacuum (a pressure approximately 13 lb. per sq. in. below atmospheric pressure).—ISADORE KOWARSKY.

Homemade Hot Water Heater

Insures Winter Car Comfort





Sketches showing the heater and how it may be installed. Being less than 2½ in. thick, it takes up very little room

IF YOUR automobile is not equipped with a suitable heater for winter driving, here is an efficient radiator that utilizes the heat given off by the motor cooling system and that costs only a few dollars to build and install.

The construction of the heater, which is of the convection type, is plainly shown in the accompanying drawings. The end plates, fins, and tubes are sweated together, and the front and back plates are held in place with rivets.

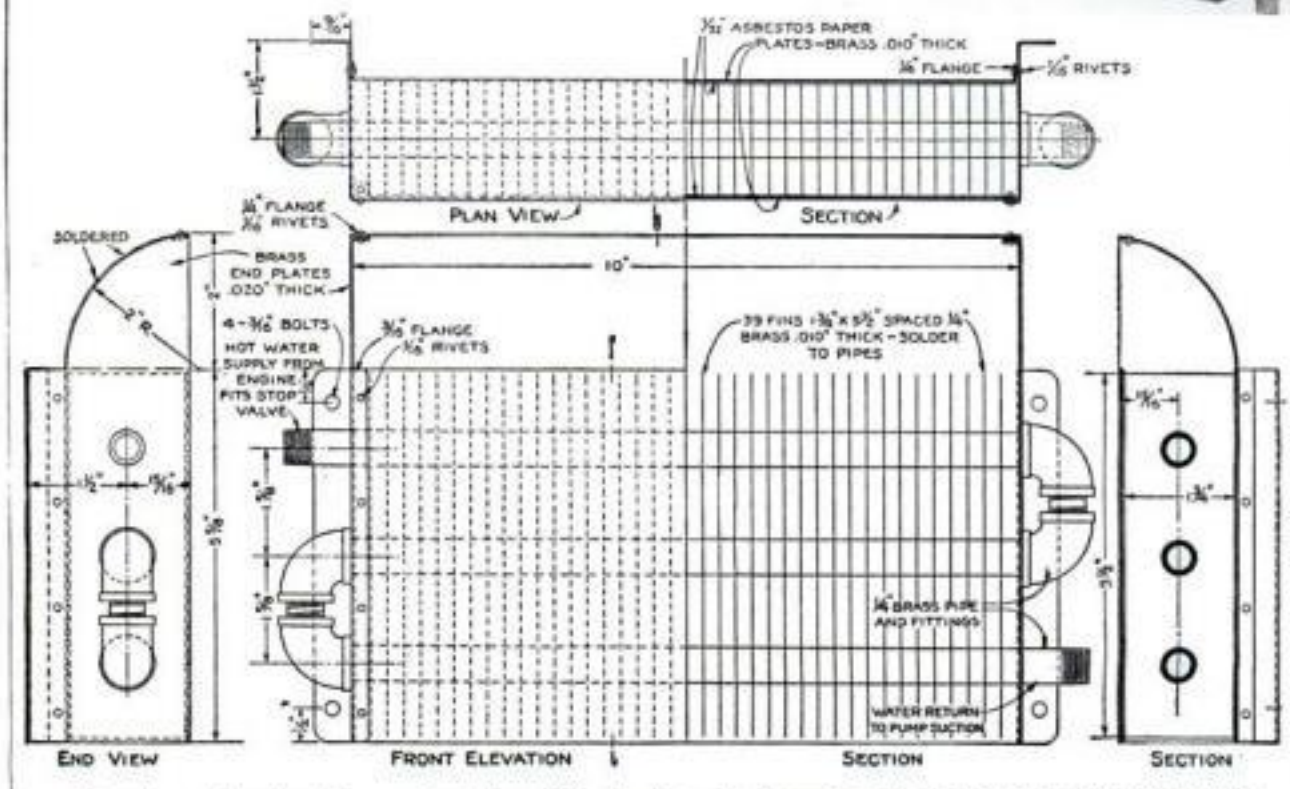
The hot water supply is taken from the water outlet manifold at a point before the thermostatic control, if the car is so equipped; or it may be taken from the cylinder block dire ; and the return water line is connected into the water system at some point near the pump. A stop valve, placed in the supply line, serves as a heat regulator.

In finishing the heater, only the outside surfaces should be painted. Mount the radiator wherever convenient, with its bottom edge 2½ in. above the floor.

If desired, the construction can be simplified through the use of the copper- or steel-finned tubes shown below at the left, which can be purchased.—COLIN L. BLAIR.

FIN ALTERNATIVE

Fins and tubing can be replaced with finned tubing, if desired



Drawings showing the construction of the heater. As shown in the photograph above, the stop valve is connected in the supply line. Supply and return lines can be copper or rubber tubing

Feb 1932

Keep his head up

and we'll all come through!

You recognize this man. He lives in your own town, not far from you . . .

Though faced with unemployment, he is combating adversity with courage. He has retreated step by step, but fighting. He has spread his slender resources as far as they will go.

This winter he and his family will need your help.

There are many other heads of families much like him in the United States. This winter all of them will need the help of their more fortunate neighbors.

This is an emergency. It is temporary. But it exists. It must be met with the hopefulness and resource typical of American conduct in emergencies.

Be ready! Right now in every city, town and village, funds are being gathered for local needs—through the established welfare and relief agencies, the Community Chest, or special Emergency Unemployment Committees . . .

The usual few dollars which we regularly give will this year not be enough. Those of us whose earnings have not been cut off can and must double, triple, quadruple our contributions.

By doing so we shall be doing the best possible service to ourselves. All that America needs right now is courage. We have the resources. We have the man power. We have the opportunity for world leadership.

Let's set an example to all the world. Let's lay the foundation for better days that are sure to come.

The President's Organization on Unemployment Relief

Walter S. Gifford

WALTER S. GIFFORD, DIRECTOR
Committee on Mobilization of Relief Resources

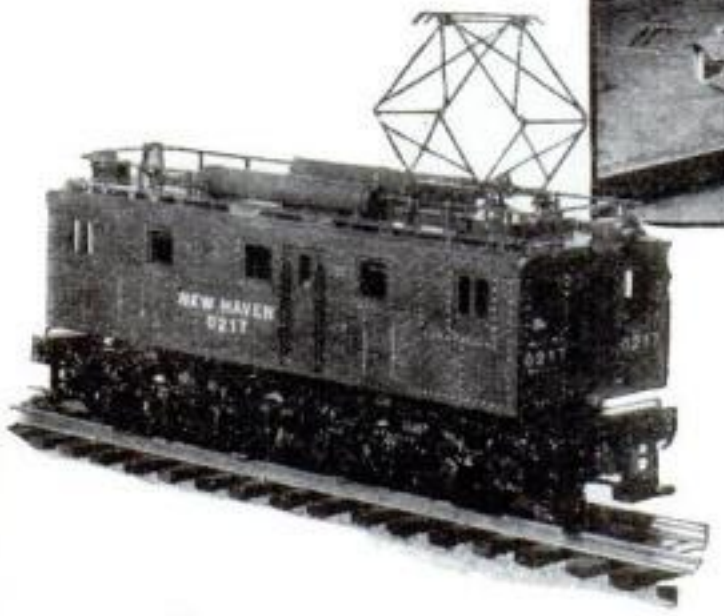
Owen D. Young

OWEN D. YOUNG, CHAIRMAN

The President's Organization on Unemployment Relief is non-political and non-sectarian. Its purpose is to aid local welfare and relief agencies everywhere to provide for local needs. All facilities for the nation-wide program, including this advertisement, have been furnished to the Committee without cost.

TOOLS *for* Model Railway Building

Tools for sheet metal work form an important part of the amateur's equipment



By

THOMAS W. ARNOLD

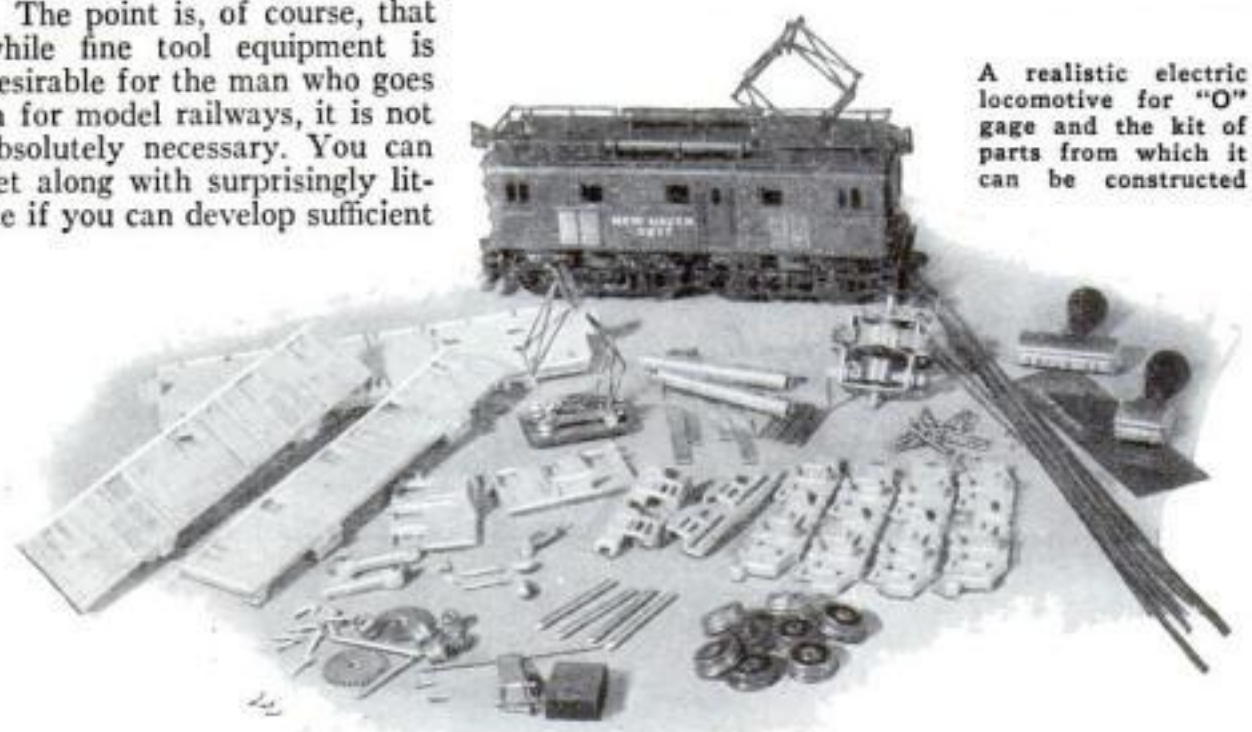
YESTERDAY I visited the workshop of an amateur model railway enthusiast who has built some excellent steam-outline electric drive locomotive models, various types of passenger cars, and a most elaborate track layout. His tool equipment is exceedingly complete and represents an investment of several thousand dollars.

A short time ago I visited another model railway enthusiast who has produced, in his own shop, just as fine locomotives and rolling stock and yet his tool equipment is so apparently inadequate that it is difficult to see how he does such fine, accurate work.

The point is, of course, that while fine tool equipment is desirable for the man who goes in for model railways, it is not absolutely necessary. You can get along with surprisingly little if you can develop sufficient skill. And that is fortunate because most of us are not in a position to buy all the equipment we ought to make our shops complete.

In building model railroads, we face more different kinds of work than does the builder of model ships, coaches, and other models where appearance is the only requirement. A model railroad must be right in looks and also in mechanical operation. This means that all parts which perform definite functions in the running of a locomotive, for example, must be of suitable material. You cannot fake working steel or brass parts by using painted wood; electrical equipment must be the real thing in miniature, and so on. Many of the external details of locomotives and passenger cars, however, are faked in the same way as similar details on ship and coach models.

Model railway building therefore calls for working in wood, cardboard, sheet metal, and a number of other materials plus a definite, though not necessarily a broad knowledge of mechanics and electricity. Moreover, skill at painting small



A realistic electric locomotive for "O" gage and the kit of parts from which it can be constructed

objects must be acquired. Many an otherwise excellent example of model railway construction has been spoiled by a crude and amateurish paint job.

The hand tools most useful to the model railway builder for working in wood are, of course, a small saw, a small hand plane, a fret saw, coarse files, and several narrow blade chisels. Power-driven woodworking tools, such as the circular saw, the jig saw, or a band saw, and particularly the sanding disk, naturally are a big help. They make it possible to do in a few minutes jobs that would take hours with ordinary hand tools. Take the problem of small wooden ties, for example. You can buy them ready cut or you can make them yourself. Ripping odd boards with a handsaw to make ties is a job that will take the starch out of the huskiest arm, yet with a good power-driven circular saw you can cut them out literally by the hundreds in almost no time at all.

WORKING in cardboard—passenger car sides are often made of this material—calls for a husky pair of scissors and an equally strong and sharp jackknife. Joints between cardboard and cardboard, or cardboard and wood, always should be made with some type of strong, quick-drying cement even in cases where rows of tiny pins are used as nails. Remember that model railway equipment must withstand the jars and vibration of actual running. I have seen an elaborately constructed passenger car, made of wood, cardboard, and metal, go to pieces on its first trip over the rails because of weak joints—and what a sinking feeling it gave me to see that early product of my handiwork disintegrate in such fashion!

Sheet metal parts of model railroads are usually made of brass because it is so easily cut with the tin shears which must be part of your equipment. The shears and soldering outfit are about all the sheet metal tools you will require, at least at the start. Sheet metal too heavy to be cut with the shears can be cut in jig time with a power-driven jig saw, or the job can be done just as well, but with the expenditure of lots more labor, by using jeweler's saw blades held in your hand fret-saw frame.

CERTAIN tools are needed in every home workshop no matter what kind of work you do. One is a drill. You must have a way of getting straight, round holes through wood and metal parts. Do not make the mistake of buying a cheap, light hand drill. The most useful size is about midway between the smallest hand drill and the breast drill. It is not absolutely necessary to get a complete set of drills from Nos. 1 to 60; the smaller sets varying by 32nds to ¼ in. will do. However, if you can afford the extra dollars, the complete wire-size set plus a stand to hold them is a great help.

If you have a spare motor with which to drive it, I recommend a flexible shaft outfit for drilling, which can be purchased complete for less than $5.

Two other necessary tools are a small square, not the big kind used by carpenters, and a steel rule. These will be used in laying out parts. A 6-ft. steel tape will be useful in measuring track formations.

Of course, the tool equipment you need depends entirely on how much you intend to build and how much you intend to buy. The illustrations on page 104, for example, show an "O" gage electrical locomotive which can be assembled from a kit of parts costing under $40. As the finished model shows, it is a very elaborate and realistic locomotive.

I HAVE left the matter of files to the last because the buying of files illustrates an important point in getting together your model railway building equipment. After you have bought as many of the obviously necessary tools as you think you can afford, add the rest, a piece at a time, as you find a definite need for the tool. When, for instance, you find that a certain filing operation has to be done, get exactly the type of file adapted for that particular job. Follow the same procedure in buying all other equipment so that, in the end, you will have assembled exactly the equipment that meets your own requirements.

Next month Mr. Arnold will discuss the metal turning lathe as applied to model railway construction.

MILK ORDER SLIPS THAT NEVER BLOW AWAY

The paper cap, put in place, holds the slip

ORDERS for extra milk are so often blown away before the milkman makes his rounds in the early morning that it pays to cut out a batch of special order slips of the shape illustrated. These may be either of wrapping paper or very thin cardboard. They are 4 or 5 in. long and have a narrow strip or tongue at the top. Write the order on the wide part of the paper; then place the narrow end under a common paper bottle cap and push the latter in place in the neck of the bottle. The cap will hold the slip firmly even in a violent storm.—L.B.R.

One simple move holds secret of this

Magic Square Puzzle

By ARTHUR L. SMITH

In solving this puzzle, the main thing is to make the right start

THIS magic square puzzle, which may be constructed easily from cigar-box wood, involves the famous 15-14 principle of Sam Loyd and is impossible to solve unless a certain move is made.

A box with a sliding cover is first prepared as shown at *A*. Its outside measurements are 5½ by 6⅜ in. The top and bottom strips are ½ in. wide; the inner ones, ¼ in. This size allows the blocks to be ⅞ in. square.

Before the box is nailed or glued together, the bottom piece should be marked out and the numbers burned or printed into the squares as shown at *B*. A ½-in. margin is allowed for the border strips. These figures on the bottom board are needed for replacing the blocks.

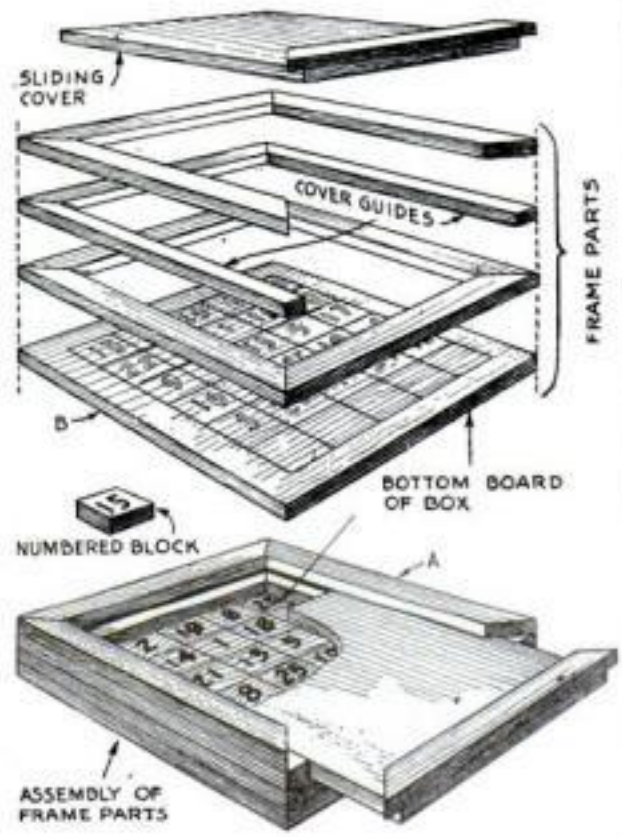
Next 27 blocks are cut out ⅞ in. square. The edges must be sandpapered or filed off slightly, otherwise they may stick and not move freely. If the pieces are stained and waxed, it will be an improvement. Two blocks are blank; the others have the numbers from 1 to 25 printed on them. Another block ⅞ by 2⅝ in. is cut out, and all are placed as at *C*.

To solve the puzzle, one of the plain blocks is removed. The blocks are then moved about without lifting any out of the box to form the position shown at *D*.

A variation may be introduced by gluing the plain oblong block in place and also block 13. In this case both plain blocks must be removed at the start.

The plain blocks are necessary in this puzzle to permit a possible solution. If the box were made square, for instance, and the central block marked 13 taken out to permit the moving of the other pieces, there would always be two numbers transposed as in the 15-14 puzzle.

The solution of this puzzle will appear in the March issue.



How the box is made, and the blocks before and after being moved. Note that the numbers arranged as at *C* add to 65 vertically, horizontally, and along the two diagonals

BLUEPRINTS

to Help You in Your Home Workshop

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. These prints are the result of a pioneer effort begun by this magazine in 1922 to provide readers with authoritative drawings at a nominal price. This service has grown to be by far the greatest of its kind. It is conducted solely for your benefit, so do not fail to take advantage of it at every opportunity.

The blueprints are clearly printed on heavy paper 15 by 22 in. In the following list the blueprint numbers are shown in italic type immediately following the descriptive title. In ordering it is necessary to give only these blueprint numbers. Where the title is followed by one number only, the blueprint is on one sheet and can be obtained for 25 cents. Wherever there are two numbers, it means that there are two sheets in the set, and the price is 50 cents. Three numbers indicate that the set consists of three sheets and costs 75 cents. In a few cases, too, there is more than one project on a sheet. A coupon is given below for your convenience in ordering. When using the coupon, be sure to enter the numbers correctly.

Airplane Models

Bremen (Junkers, 3-ft. Flying), *89-90*	$ .50
Combination, 20-in-1, *135-136*	.50
Lindbergh's Monoplane (3-ft. Flying), *69*	.25
Rise-off-Ground Tractor, 3-ft., *50*	.25
Seaplane, Tractor, 30-in., *87*	.25
Seaplane, Morris (Record 12½ min.), *102*	.25
Single Stick, Tractor, 30-in., *82*	.25
Tractor (Record Flight 6,024 Ft.), *104*	.25
Twin Pusher, Racing, 35-in., *86*	.25
Winnie Mae (4-ft. flying), *141-142-143*	.75

Boats

Canoe, Sailing Outfit, *25*	.25
Outboard Racer, 11½-ft., *128-129*	.50
Sailboat-Motorboat, Combination (15 ft.), *131-132-133*	.75

Furniture

Bookcase, Modernistic, *88*	.25
Bookcase, Simple, *37*	.25
Book Ends, Modernistic, *100*	.25
Bookshelf, Modernistic, *100*	.25
Bookshelves, Hanging, *77*	.25
Bookstand, Modernistic, *88*	.25
Book Trough, *68*	.25
Broom Cabinet, *49*	.25
Cedar Chest, Mahogany Trimmed, *17*	.25
Chair, Rush-Bottom, *36*	.25
Chest of Drawers, Salem, *39*	.25
Chests, Treasure, *78*	.25
Clock, Grandfather, *19*	.25
Desk, Colonial, *21*	.25
Desk, Flat Top, *20*	.25
Desk, Sheraton Writing, *40*	.25
Dresser, Welsh, *60*	.25
End Table, Magazine, *68*	.25
Kitchen Cabinet, *5*	.25
Kitchen Table Cabinet, *27*	.25
Lamps, Modernistic, *93*	.25
Mirror, Scroll Frame, *105*	.25
Pier Cabinet, *77*	.25
Radio Cabinet, Console, *70-71*	.50
Screens, Modernistic Folding, *91*	.25
Sewing Cabinets, Two, *31*	.25
Sewing Table, *1*	.25
Shelves and Lamp, Modernistic, *93*	.25
Shelves, Corner, *77*	.25
Smoking Cabinet, *2*	.25
Stand, Low Modernistic, *100*	.25
Table, Gate-Leg, *24*	.25
Table, Sheraton, *38*	.25
Table, Tavern, *105*	.25
Table, Tilt-Top, and Bench, *11*	.25
Table, Tilt-Top, Oak (Top 20 by 24 in.), *140*	.25
Tea Wagon, *13*	.25
Telephone Table and Stool, *18*	.25

Radio Sets

Amplifier, Three-Stage, Audio-Frequency, *42*	.25
Five-Tube (Battery Operated), *54-55*	.50
Four-Tube (Battery Operated), *43*	.25
Full Electric Headphone Set, *130*	.25
One Tube (Battery Operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25

Ship and Coach Models

Barque, Scenic Half-Model, *108*	.25
Bottle, Clipper Ship in, *121-122*	.50
Clipper, Baltimore (8-in.), *92*	.25
Clipper—*Sovereign of the Seas*, *51-52-53*	.75
Constitution ("Old Ironsides"), *57-58-59*	.75
Covered Wagon, *118-119-120*	.75
Destroyer—U. S. S. *Preston* (31½-in. Hull), *125-126-127*	.75
Galleon, Spanish Treasure, *46-47*	.50
Mayflower (17½-in. Hull), *83-84-85*	.75
Motorboat, 29-in. Toy, *63-64*	.50
Pirate Galley or Felucca, *44-45*	.50
Roman Galley (19-in.), *138-139*	.50
Santa Maria (18-in. Hull), *74-75-76*	.75
Schooner—*Bluenose*, *110-111-112*	.75
Sedan Chair, Queen's, *123-124*	.50
Stagecoach, Concord, *115-116-117*	.75
Stagecoach (Cody), Small, with Horses, *144-145-146*	.75
Steamboat, Mississippi, *94-95-96*	.75
Viking Ship, *61-62*	.50
Weather Vane, Ship Model, *66*	.25
Yacht, *Sea Scout*, 42-in. Racing, *106-107*	.50
Yacht, 20-in. Racing, *48*	.25

Toys

Airplane Cockpit with Controls, *114*	.25
Birds and Animals, *56*	.25
Broncho, Doll's House, and Train, *14*	.25
Doll's House, Colonial, *72*	.25
Doll's House Furniture, *73*	.25
Drill Press, Woodturning Lathe, Jointer, and Circular Saw, *113*	.25
Dump Truck, *101*	.25
Garage, *29*	.25
Fire Engine, *101*	.25
Lindbergh's Plane, *67*	.25
Play Table, Pullman, *28*	.25
Sprinkler Truck, *101*	.25
Tea Wagon, *29*	.25
Tractor, *101*	.25
Wheelbarrow, Bunny, *29*	.25

Miscellaneous

Arbor, Gate, and Seats, *9*	.25
Baby's Crib and Play Pen, *26*	.25
Bench Hook, Combination, *30*	.25
Boring Gage, *30*	.25
Garage, One-Car, Pergola, *23*	.25
Log Cabin (Three Rooms), *134*	.25
Puzzles, Six Simple Block, *65*	.25
Swing, Porch, *10*	.25
Tool Cabinet, *30*	.25
Trellises, Garden, *34*	.25
Workbench, *15*	.25

Popular Science Monthly
381 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows:

No..... No..... No..... No.....
No..... No..... No..... No.....
No..... No..... No..... No.....

I am inclosing.....dollars.....cents in payment (25 cents for each number).

Name .....

Street .....

City and State .....

Note: Please print your name and address very clearly. If you do not wish to cut this page, order on a separate sheet.

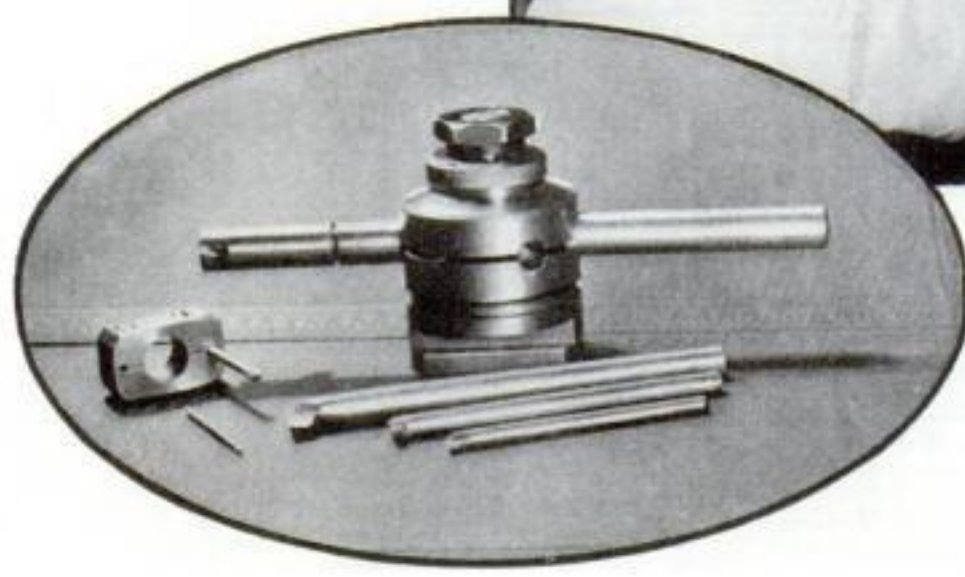
A definite program for getting ahead financially will be found on page four of this issue

THE HOME MACHINIST ADDS A

Boring Tool *to his* Equipment

By HOLT CONDON

How the main body or barrel of the holder is set up in order to drill holes for three sizes of boring bars



In the oval is shown the completed boring tool with a 9/16-in. boring bar in place. It carries a cap or tip in which the cutter itself is mounted. Several smaller bars are also illustrated

THE boring tool illustrated above follows logically the jobs already described in this series (P.S.M., Nov. '31, p. 115, and Dec. '31, p. 106) and may be attempted with success by the handy man who has an engine lathe and the limited equipment already described —a mounted four-jaw chuck, lathe dog, cross-feed stop, knurling tool, and a set of drills.

Reamers are rare in the home shop, but a bored hole finished with a tool properly ground and honed and supported in this rigid holder will produce results that are comparable in accuracy and finish to reamed holes. For sizing these bored holes, it is a good plan to collect short pieces of drill rod and such automobile parts as wrist pins, which are accurately ground to common fractional sizes, and to use them as plug gages.

As a nucleus upon which to build this tool, the writer bought the two caps to fit a standard 9/16-in. boring bar and designed to hold inserted cutters. One of these caps or tips mounts a tool at 90 deg. with the bar, and the other at 45 deg. A tool steel bar was centered and turned up and a thread chased on its end to receive either cap.

The body of the holder, 2¼ in. in diameter and 2⅛ in. high, was next worked up from a piece of cold-rolled shafting. It was chucked bottom out, drilled through to ⅝ in. and counterbored to 1 in. with the new bar held in an improvised set-up. The smaller diameter was knurled. An encircling groove was then turned 15/16 in. from the base to locate the level of the three holes to be drilled through its center, and the piece was cut off.

It became necessary at this point to bring the cleat for the lathe slot and the stud to completion in order to mount the body or barrel for drilling the three radial holes. This cleat was turned as a disk, bored to 1 in. for the stud, and counterbored for the flange of the stud. Flats and shoulders were worked out in the vise with saw and file, and spotted for a fit in the slot of the lathe compound rest with the aid of copper sulphate solution.

The stud was turned on centers from a piece of 1¼-in. shafting and shouldered down to ⅝ in. for the thread (⅝ by 18 S.A.E.), which was chased to fit an automobile steering-wheel nut, which happened to be on hand.

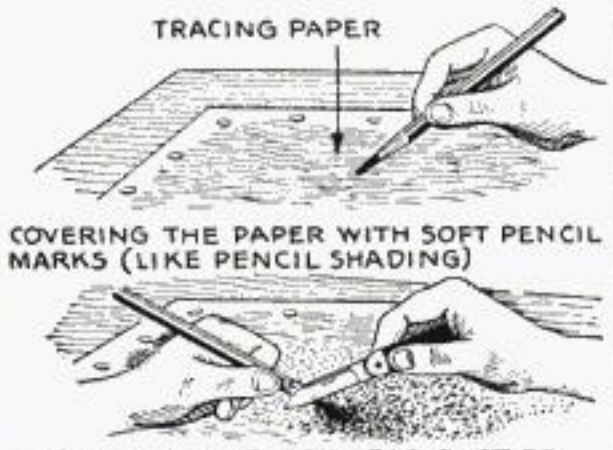
The barrel of the holder was laid off into sixths around the central groove and these points prick-punched to locate both ends of the three holes for assorted bars ¼, ⅜, and 9/16 in. in diameter. The assembled parts were located by means

of the lathe centers and drilled as illustrated. The barrel was then split on the line of hole centers with a hack saw, and the two halves were faced off in the lathe. The hole in the stud thus formed was elongated axially with a file, and a small dowel was set in the flange of the stud. This dowel, registering with notches in the cleat, serves to fix the different angular positions required and holds against the tightening of the nut.

The smaller bars were forged to shape from drill rod and hardened. The small split block with casehardened clamping screws adapts the tool to boring very small holes. Mounted on the plain end of the big bar, it holds rigidly the tiny bars illustrated. One of these was ground from a dental tool and is capable of working in a 1/16-in. hole.

This series will be continued with other articles to help the home machinist design and make his own auxiliary equipment. So far, no working drawings have been given in the series for the reason that Mr. Condon wishes to encourage beginners to do their own planning and make their own sketches from the start. Not only will this help them to progress faster, but they will experience the additional satisfaction of having done each job entirely themselves.

PREPARING HIGH-GRADE TRANSFER PAPER



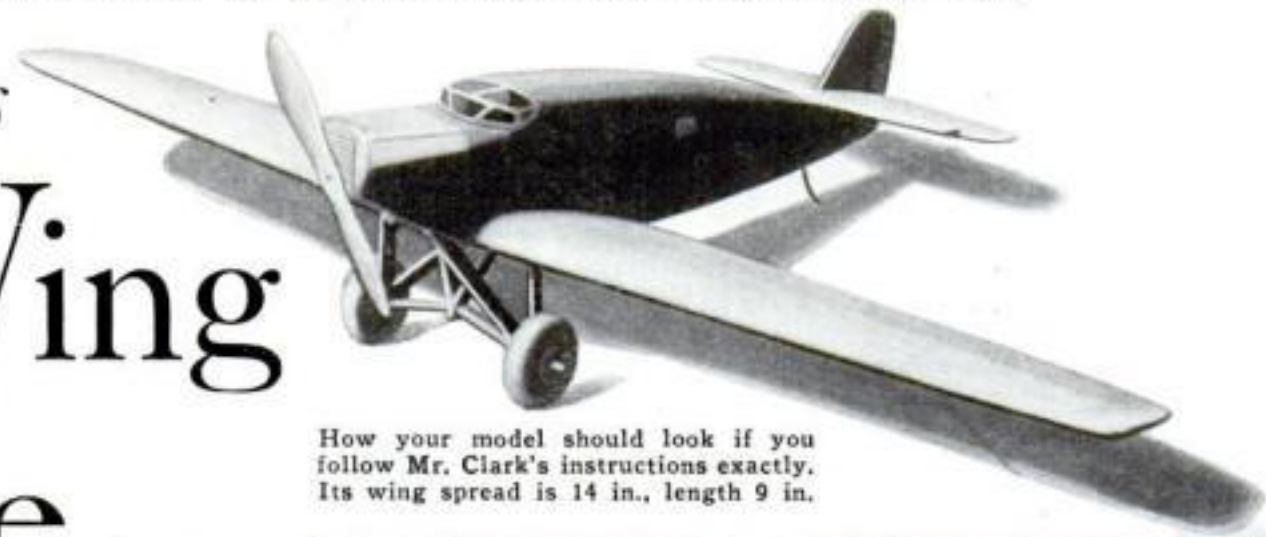
THOSE who do art craft work, as well as artists and draftsmen, frequently use carbon paper for transferring designs. The ordinary commercial carbon paper, however, is unsatisfactory for fine work, especially as it smudges easily and makes lines which cannot readily be erased. A much better grade of transfer paper for artistic work can be prepared at home in as large sheets as are needed.

Thumb-tack a piece of strong tracing paper on a board with a sheet of smooth white paper or bristol board underneath. Scribble the surface thickly with soft lead pencil strokes; then sprinkle graphite powder or pencil scrapings over the partially blackened sheet and rub the graphite vigorously into the paper with a wad of cloth. As the final and most important step, rub it again with a cloth saturated with benzine. This will leave the paper with an even and very sensitive coating.—J. D. G.

• How to Whittle a Simplified Model of

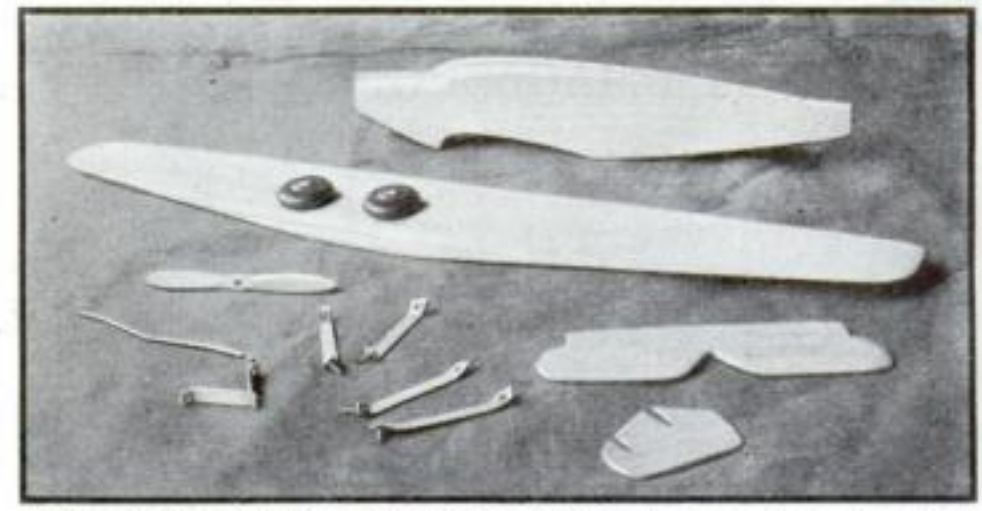
A Famous

Low-Wing Plane



How your model should look if you follow Mr. Clark's instructions exactly. Its wing spread is 14 in., length 9 in.

By DONALD W. CLARK



The extreme simplicity with which model airplanes can be constructed by the methods described in the present series of articles was never better illustrated than in this photograph, which shows the few parts needed for building the Junkers plane, all of them very easy to make

MODEL builders who have not the time or patience to go into the construction of complicated scale model airplanes will find that a realistic and, in all important respects, an accurate model of a Junkers low-wing monoplane can be made by following the drawings below. It was a ship of this kind, the *Bremen*, that made the first nonstop flight across the Atlantic from Europe.

Only thirteen units are required. As in the case of the previous eighteen models in this series, the principal parts are of white pine. The wing is sawed from a piece ⅜ by 2½ by 14 in. It is tapered as indicated in the top view. The upper part is straight, as shown in the front view, but the underside is planed in a taper toward the tips, beginning at a line ½ in. from the center. The wing is fastened to the fuselage with two brads, one 1 in. and the other ¾ in. long.

The fuselage is shaped with a saw and a sharp knife from a pine blank ¾ by 1½ by 8⅜ in. The wing seat is easily cut out with a fine-toothed coping or fret saw. A slot is sawed at the rear end to take the vertical tail, which is held tight with a small brad.

The horizontal tail is made of thin metal and fastened with two brads, although this unit could be made of ⅛-in. wood and attached in the same manner.

Five metal struts make up the landing gear, which is held to the fuselage with six nails. The axle is bent in three places and passes through holes at the bottom of the V-brace strut. Shock absorbers are made by wrapping and gluing paper around the struts. The wheels are cut from ⅛-in. wood and are ¾ in. in diameter. Small washers are placed on both sides of the wheels, and the ends of the axle are flattened to hold them on.

This model can be painted aluminum or light gray all over and trimmed with dark gray. The corrugated effect may be obtained by lining all surfaces with dark gray lines, but this is unnecessary on such a small model unless the builder wants to gain an especially impressive effect. The radiator, windows, and struts should be painted dark gray.

The most famous of all Junkers planes is the Bremen, *which crossed the Atlantic Ocean from Baldonnel, Ireland, to Greenly Island, Newfoundland, on April 12-13, 1928. Those who wish to build a 3-ft. flying scale model of this historic airplane can obtain complete working drawings by sending fifty cents for* Popular Science Monthly *Blueprints Nos. 89 and 90 (see page 107).*

AUTOMATIC CHECK-DRAFT REGULATOR FOR HOME HEATING PLANTS

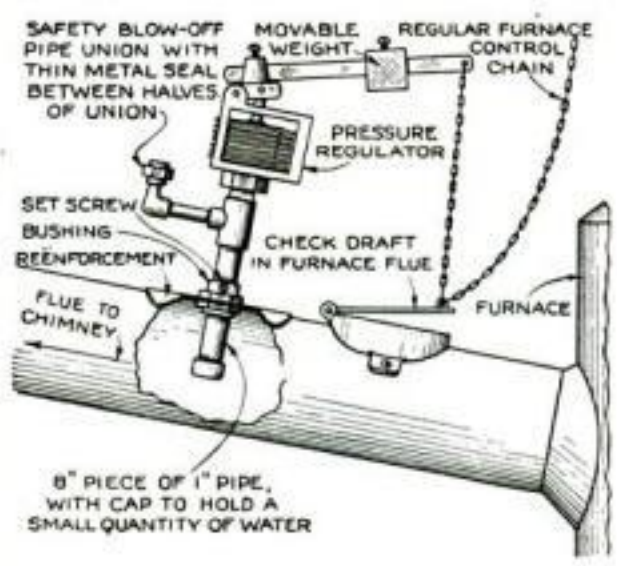
FOR any coal- or coke-fired furnace, much fuel that is ordinarily wasted in overheating the house, furnace, flue, and chimney can be saved by the use of an automatic check-draft regulator like that illustrated. It will also reduce the fire hazard.

The device consists of a boiler pressure regulator of the copper bellows type and a few pipe fittings which really form a miniature boiler in the flue. It should be adjusted to open the check draft at a flue-gas temperature of approximately 280 deg. F., which means that the steam pressure in the device will be about 30 lb. per square inch above atmospheric pressure. It is very important that all the joints be perfectly steam-tight, so that the water in it will not boil dry.

When the flue-gas temperature reaches 280 deg. F., this device opens the check draft

The safety blow-off is merely a "weak spot" purposely provided to prevent the copper bellows from being blown up if the pressure should ever become too high. A piece of soft metal from a tooth-paste tube will serve this purpose when set between the halves of the pipe union.

The writer has used one of these regulators through two heating seasons with even better and more economical results than were expected.—T. R. WATTS.



Drawing showing how the regulator is hooked up. Notice miniature steam boiler in flue

Generating SMOKE and STEAM for

Amateur Theatricals

By

KENNETH MALCOLM

CURLING wisps of smoke rising in a fireplace, great smoke-gusts bursting in from an offstage forest fire, steam issuing from grotesque modernistic machinery or even from the spout of a humble teakettle—all the realistic steam and smoke effects which so often add to the interest of professional dramatic productions can be easily duplicated, at least on a moderate scale, by the amateur.

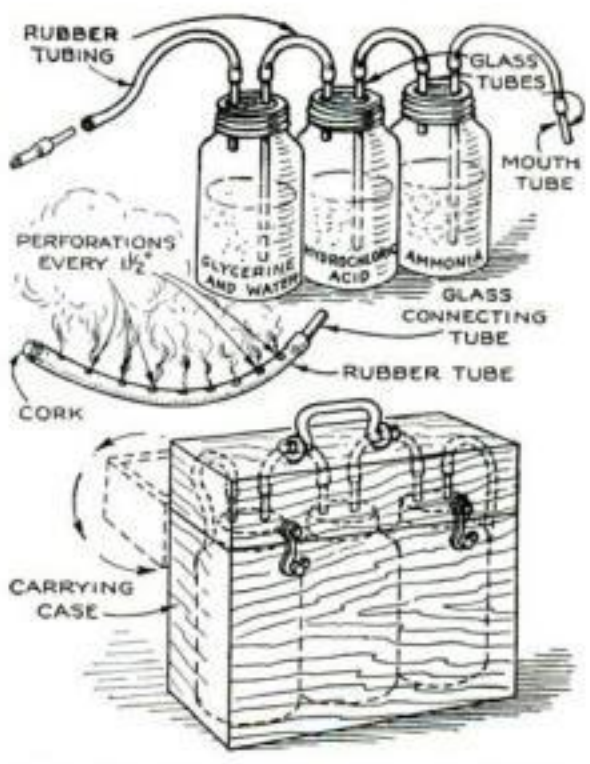
The apparatus to be described is a simplified version of that used in the professional theater, and costs not more than a dollar or two. The smoke—produced chemically by uniting ammonia gas with chlorine—is harmless and may be generated instantly wherever desired.

Obtain three 1-pt. fruit jars with screw caps, about 3 ft. of ⅜ in. outside diameter glass tubing, some sealing wax, and 6 or 7 ft. of ⅜ in. inside diameter rubber tubing. Except for the chemicals and perhaps a box or rack, these are all the materials necessary.

From the glass tubing cut three pieces 6 in. long, and three 3 in. long. This may be done with a tube cutter or simply by notching the tubing with a small triangular file and—with the tubing held in your two hands so that the notch is away from you—breaking at the notch.

Beneath the cap of each jar will be found an inset of white glass. As this cannot be drilled with ordinary drills, carefully break it out. Then, through the top of the caps, drill two ⅜-in. holes, as indicated in the drawing.

Inside of each cap now melt a thin layer of sealing wax by heating the cap over a spirit lamp or a low gas flame.



How the apparatus for making stage smoke is arranged, and a suggestion for a case

Blowing into the mouthpiece causes a cloud of white smoke to pour from the outlet tube

This is to prevent the chemicals from eating the metal. Next, seal one long and one short tube into each cap by applying a generous mound of wax on the underside of the cap. Allow the tubes to project about 2 in. above the top.

AT A druggist's or a chemical supply house, buy about 4 oz. each of concentrated ammonia, commercial hydrochloric acid, and glycerine. Pour the acid in one jar, ammonia in another, and glycerine in the third. To each add water until the solution reaches the middle of the jar. Do not put the chemicals into the jars until the covers are ready to be put into place, because the ammonia and acid give off very penetrating and disagreeable odors (perhaps even dangerous) and soon lose their strength.

When the caps are in place, the jars must be air-tight. If rubber rings or gaskets are lacking, a heavy coat of vaseline applied to the thread of the caps will make an adequate seal.

The three jars should be connected with two short lengths of rubber tubing as shown—the longer glass tube of the center jar being connected to the shorter tube of the first, and the shorter tube of the center jar being connected to the longer tube of the third. It is very important that they be arranged in correct order —first ammonia, second acid, and third glycerine. The glycerine solution acts as a sort of filter.

About 2 ft. of rubber tubing should be connected with the long tube of the first jar. A short length of glass tubing should be inserted in the other end for a mouthpiece. One end of the remaining length of rubber tubing should be pushed over the short tube of the third jar.

Blowing into the mouthpiece will cause

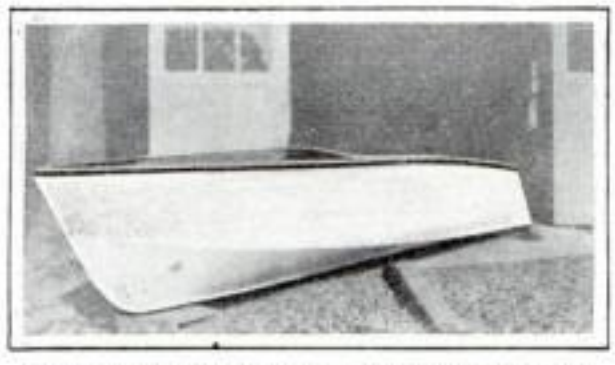
white smoke to pour from the tube at the other end of the apparatus. It may be led by the tube wherever desired. Instead of coming from a single point, the smoke may be distributed. An attachment for this purpose may be made by taking a 2-ft. length of rubber tubing, corking one end, inserting a short glass tube in the other end for aid in connecting, and cutting a line of holes at intervals of 1½ in.

To assist in transporting and storing the apparatus and prevent the jars from being overturned, it is advisable to construct a rack or a complete case.

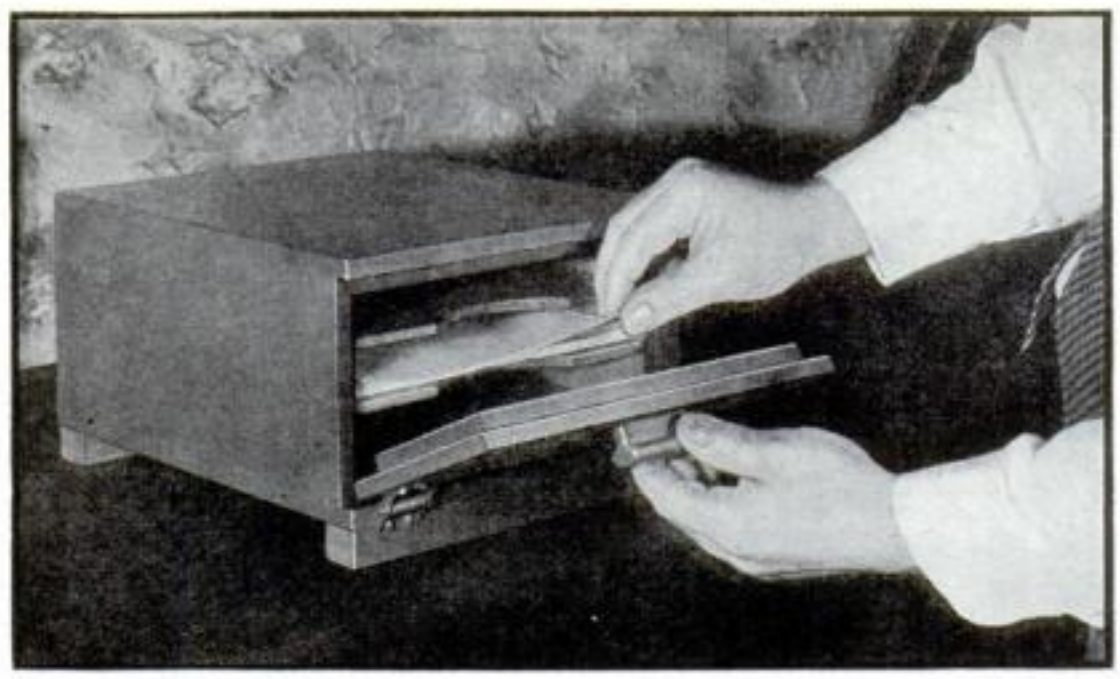
Commercial smoke apparatus is generally operated by air that has been compressed in a tank by a hand pump. This arrangement may be imitated by amateur builders, if so desired, but lung power is much cheaper and less complicated.

MAKING A YACHT MODEL LEADS BOY TO BUILD 16-FT. MOTORBOAT

THIS 42-in. racing yacht model was built by Harry C. Scanlon, of Brooklyn, N. Y., from our Blueprints Nos. 106 and 107 (see page 107). His success was so encouraging that, although only fifteen years old, he saved enough money from his weekly allowance to buy the materials for the 16-ft. outboard motor boat shown below, which he constructed unaided from plans published in the June and July, 1929, issues of this magazine and reprinted in the Home Workshop Manual. He is a high school student.



Motorboat built by young Scanlon. Plans for it are given in the Home Workshop Manual



This lightproof box with a spring-operated door prevents practically all danger of fogging one's supply of bromide paper during the process of enlarging photos

Spring-Door Box for Paper

Aids in Making Photo Enlargements

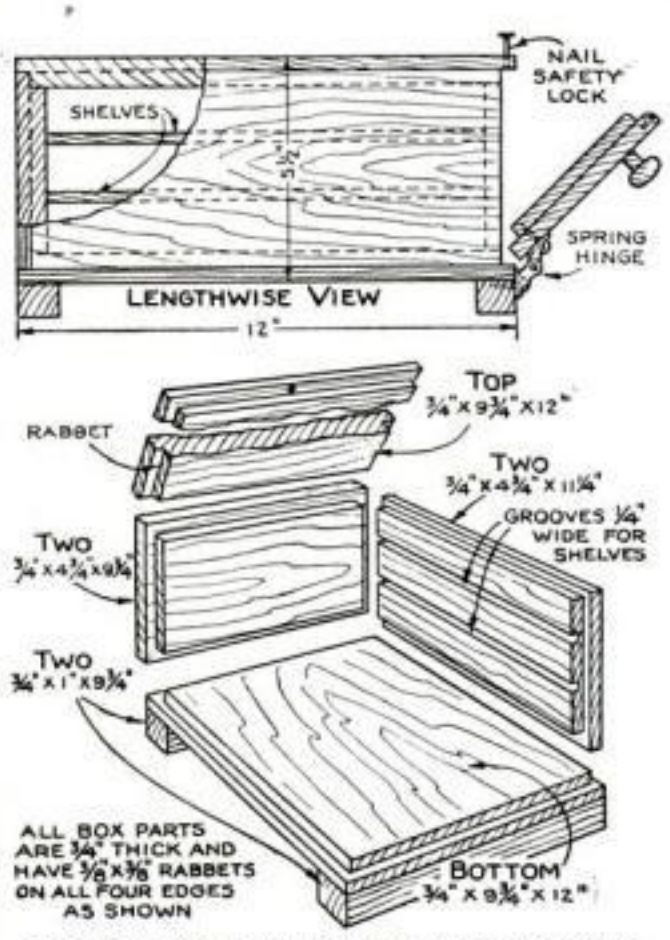
HANDLING bromide paper while making photographic enlargements so as not to fog the unused sheets ordinarily is a nuisance. The package has to be opened, a sheet extracted, and the package folded up again.

A specially built box with a spring-operated door will eliminate this trouble. Furthermore, as the spring hinges automatically close the door light-tight when you let go the knob, there is no chance of turning on the white light while the unused paper is exposed.

The size of the box should be determined by the size of bromide paper you use. The box illustrated was made to hold 8 by 10 in. paper, and the shelves allow three different kinds to be available without opening any packages. To obtain a sheet of paper, swing the door down by means of the knob, remove paper, and let go the knob.

The construction of the box is extremely simple if you have the ordinary type of home workshop power saw with a dado head. The drawings show how every joint is rabbeted so that no light can leak inside.

Assuming that you have a supply of ¾-in. boards on hand, the first step is to cut two rectangular pieces 9¾ by 12 in., then two pieces 4¾ by 11¼ in., and two more pieces 4¾ by 9¾ in. This gives you the top, bottom, sides, and back and a piece for the swinging door. Now set up the dado head on the saw to cut a rabbet measuring ⅜ by ⅜ in. and rabbet all around the edges on one side of each board. Assemble the pieces temporarily as shown in the drawings to see that everything fits. Note that no light can get in at a joint without passing around two right angles. Fortunately for the bromide paper, light won't do this.



End view of the assembled box and how the individual parts appear when rabbeted and grooved

The next job is to groove the side-pieces (those measuring 4¾ by 11¼ in.) for the two shelves, which can be cut to fit from ¼-in. plywood. Cut a semicircle out of the front edge of each shelf to facilitate sliding out the paper.

Now glue or nail the box together with the exception of the end which is to be fitted as a door with spring hinges at the bottom. Nail two cleats ¾ by 1 by 9¾ in. across the front and back edges of the bottom. They keep the box off the table and out of any developing solution that may get spilled while you are working, and the front cleat serves as a base for the spring hinges. It will, of course, be necessary to plane off part of the upper edge of the door to allow it to swing into place. Any convenient home-made or purchased knob can be fitted.

It is desirable to add a simple lock

in the form of a hole drilled down through the center of the upper front edge of the top and into the edge of the door. When the box is not in use, drop a nail into the hole to prevent the door from being accidentally opened and the paper spoiled.

As paint should be avoided on the inside of the box, leave the wood bare or give it a coat of shellac. The fumes of drying turpentine given off by paint have a bad effect on bromide paper. The outside of the box can be finished in shellac or lacquer to protect it from the stains of spilled solutions and wear due to handling.—F. D. R., JR.

TIGHT GLASS STOPPERS LOOSENED IN VISE

Tightening the vise loosens the stopper

ONE never-failing method of removing a tight glass stopper from a bottle is to use two hardwood dowels and a bench vise as illustrated. Place one of the dowels on each side of the stopper and squeeze them in the vise as shown. The wedging action will loosen the tightest stopper. Short lengths of different sizes of dowels may be kept on hand at the workbench to take care of a large variety of sizes and shapes of stoppers.—BURL KNUTSON.

SPECIAL CEMENT RENEWS OLD STOVE LININGS

WHEN the lining of a kitchen stove or range cracks and crumbles away, it often happens that the local repairman does not carry in stock the replacement parts. My plan in such an emergency was to wash the broken bricks remaining in the stove and, after they had dried, apply a coating of water glass (sodium silicate solution) on all the edges which needed to be built up with new clay. The cracks and holes were then filled with ordinary clay mixed with equal parts of asbestos fiber and plaster of Paris and moistened with sufficient water glass to make a thick, doughy paste. When this had been well smoothed, it was coated with water glass and allowed to dry for twenty-four hours or longer. The repair gave me one full year of service.—H. J. BLAKE, M. D.

MAKING CURVED FRONT FURNITURE

(Continued from page 100)

that the face is straight the entire width of the front.

The veneer preferably should be 1/12 in. thick and certainly not less than 1/16 in. thick. Cut it at least 1½ in. wider and 3 in. longer than the front core. Provide a sheet of zinc about the size of the veneer or use a newspaper to prevent the glue from sticking to the face of caul *E*, which should be smoothed.

Mark center line *G* on the tops of cauls *E* and *F* and the top of the drawer front which is to be veneered. Be sure these lines coincide when the hand screws are applied. Try all together before applying the glue. It may be wise to have help when the hand screws are being applied, for it is important that the top of caul *E* and of the front coincide.

WHEN the fronts have been veneered, trim the veneer to the edges and ends without splintering it, and cut the fronts about 1/16 in. longer than the exact distance between shoulders *H* of the front partition rails. Take care that the center line *G* is in the middle. Plane each front down to about 1/16 in. wider than its respective opening, but do not fit them.

See that the five partition rails are placed exactly in position in the temporarily set-up case. Make a knife mark on the bottom of the top rail at *H* of each end and on the top of each of the other four rails at *H*. Number each rail. Take down the case, place the front bottom corners of a drawer front exactly to the knife mark *H* at each end of one of the rails, and draw a pencil line on the rail to show where it is to be band sawed. Number each front the same as the rail which is marked by it. Work the rail to this mark, and its curve will then coincide with the face of the drawer at the lower edge—an important consideration. If there is any slight variation at the top of the drawer, it will be less conspicuous. The top rail must be marked on the underside from the top of the upper drawer front.

Make a core for the front base by the same method used in preparing the drawer front cores; this must fit the front of the bottom rail. Cut the curve of the lower edge by transferring the outline to full size 4-in. squares as indicated.

When the case is assembled permanently, the rails must go as they are numbered and the case must be square or there will be trouble in fitting the drawers. Nail the back (of ½-in. boards or plywood) securely to the back partition rails *K*.

MAKE the two feet *L*, right and left, and cut out the edge of each end at *M* to receive them. Fit the front base in place, join it to the feet, and fasten permanently with glue, screws, and reënforcing blocks. Make and glue in place piece *N* to carry out the curve of the foot *L*, and do the same to the back foot at *O*. Shape each piece after it has been glued in place.

The drawer fronts are fitted and the drawers made very much like ordinary straight drawers, for the front is straight at the ends. The construction is shown in the sectional views. The drawers may be halved or dovetailed at the corners. A groove *P* may be made in each front for the drawer bottoms, or the bottoms may be fitted and held with nearly continuous glue blocks (triangular) as at *Q*.

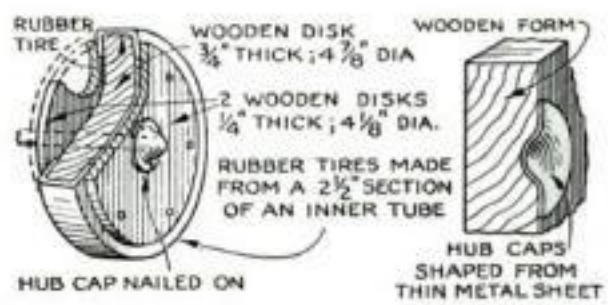
Fit each drawer closely. Put each drawer in place, bring it to the front to test the surface accuracy of the front and rails and smooth, scrape, and sandpaper all carefully. Each drawer should be stopped about 1/16 in. back of the face of the rail. This may be done by cleats against the front as at *R*, one near each end, glued and bradded to the rail; or a stop may be placed at the back as at *S*; the former is better practice.

Make the top, shape the front edge, and fasten with screws through the top rails and drawer runs. Fit the locks and trimmings. Smooth and sandpaper everything carefully, remove finger marks and other blemishes, touch all sharp corners lightly with fine sandpaper and the chest will be ready for finishing.

AN EASY WAY TO MAKE WHEELS FOR TOYS

MOST home workers who have no lathe would take greater pleasure in constructing toys if they knew of some easy way to make wheels. After a little experimenting, I found that wheels for the dump truck shown on POPULAR SCIENCE MONTHLY Blueprint No. 101 (see page 107) and similar toys could be made by the following simple method, which would also be suitable for larger wheels.

The truck required wheels 4⅞ in. in diameter. These I cut from ¾ in. thick five-ply veneer, though the end of an apple box would have done just as well. Two disks of ¼-in. three-ply veneer 4⅛ in. in diameter also were cut for each wheel. This was done by mounting the blanks one at a time on a board by means of a bolt, nut, and two washers, and clamping the board to the bench so that the plywood could be revolved as it was sawed with a coping saw. The wheels were then assembled as shown with tires made by cutting 2¼ in. long sections from a small, discarded inner tube. The axles were riveted over at the ends against washers.



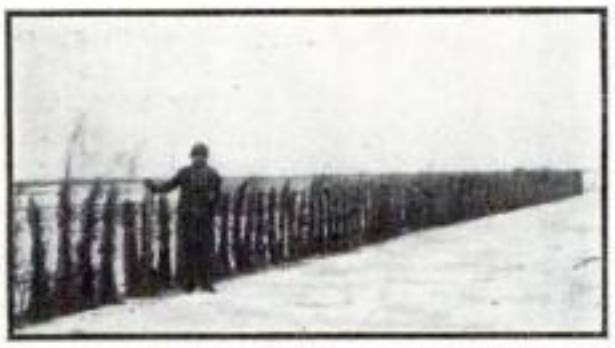
A completed wheel cut away to show the construction, and how the hub caps are formed

Hub caps were shaped from thin sheet metal by hammering them lightly with a ball pein hammer over a depression with rounded edges made in a scrap of wood. They were then trimmed round. A little grease was placed under each hub cap before it was fastened in place with small nails.—BRYAN REDINGTON.

FARMSTEAD SNOW FENCE MADE FROM STALKS

BEFORE the heavy blizzards set in, it is well to provide protection against excessive snowdrifts on any farmstead where snow causes trouble. This can be done without the purchase of one penny's worth of material.

Locate a barbed wire fence or a woven wire fence a few rods away from the farm

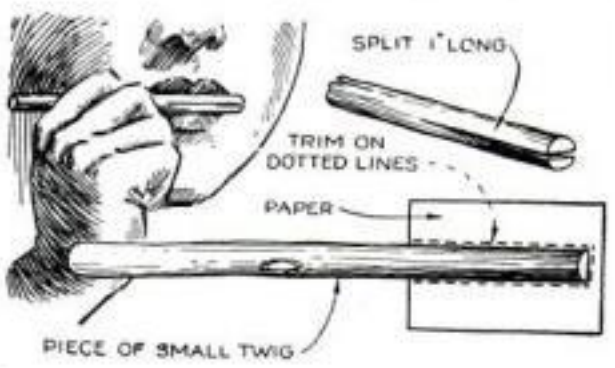


A cornstalk fence such as this will protect your buildings from heavy snowdrifts

buildings on that side from which the prevailing winter winds blow. This permanent fence will serve as a framework for a temporary snow fence. Prepare a number of bundles of Soudan grass, cornstalks, or even sunflower stalks, each bundle being about 6 in. in diameter, and tie these in a vertical position to the fence, leaving 3-in. spaces between. Use ordinary binding twine and tie each bundle at the top or about 3½ ft. above the ground and also at the bottom about 1 ft. from the ground.

A farmstead snow protector of this type is the same in principle as the slatted snow fences used for public highways. Indeed, the homemade fence is better than the slat type for several reasons: There is no original cost or investment for posts or fence; there is no framework to be put up and taken down; and no additional ground is required.—CAP E. MILLER.

HOW A BOY CAN IMITATE THE CAW OF A CROW



WITH the aid of a twig the size of a lead pencil and a bit of writing paper, any boy can imitate the caw of a crow. Square off one end of the stick and split it down the center for about 1 in. Wedge a piece of writing paper in the opening as shown; then trim off the paper around the sides and end of the stick. Place the side of the stick between the lips in such a position that the paper will be free to vibrate. With a little practice, a realistic caw can be made simply by forcing the breath through the opening, so as to make the thin piece of writing paper vibrate, and modifying the sound with mouth and tongue.—GEORGE A. SMITH.

A definite program for getting ahead financially will be found on page four of this issue.

SOLID MAHOGANY TRAY-TOP TABLE

(Continued from page 79)

the joint between the column and the top pinth. If you have a set of small hand screws (the 8- or 10-in. size is large enough), clamp one of them vertically on the leg as shown in the upper right-hand corner of page 79. A piece of sandpaper doubled over with the abrasive side outward may be placed between the jaws of this clamp and the leg to make it hold better. A study of the illustration will reveal more quickly than any explanation how the clamping is done. One jaw of the second hand screw is set to bear against the first hand screw, and its other jaw bears against the column opposite the joint. A third hand screw can be applied lower down if the joint fails to close properly at the bottom. Unless you have had experience with hand screws, clamp the joint together without glue to make sure that the first clamp will not slip and that the other clamps are properly adjusted. Then apply glue to the dowel holes and to the surface on the leg that comes into contact with the leg post. In clamping the leg, do not draw up the hand screws tighter than is necessary to make a clean joint between leg and column. Allow the necessary time for the glue to set (according to the glue used) and repeat this process with each of the other legs in turn.

Hand screws are so useful for all work of this nature and are so inexpensive, that it pays to have at least four, but you can get along without them. Simply apply the glue and press the leg into place firmly with your hands, hold it for a short time, and set the parts aside so gently that the joint is not disturbed. With parts machined as perfectly as these, such a joint will be quite satisfactory, provided a high-grade glue is used.

The next step is to cut off the spline and dowel where they project through the top of the plinth *B* so that they are even with the surface. Then attach the plinth to the top with screws and glue, measuring carefully to see that the top is centered over the column. The grain in the top and in the plinth should cross each other.

Before going ahead with the finishing, remove all glue that has been squeezed out and smooth all surfaces of the pieces with No. 00 sandpaper. In most of the kits a piece of scrap wood will be found; use this for practicing with the finishing materials, or practice on the underside of the top.

Open can No. 1 containing the stain coat and stir it well; also stir it from time to time so that the compounds do not settle to the bottom.

Apply the stain coat with a full brush, covering the entire *(Continued on page 119)*

SOLID MAHOGANY TABLE

(Continued from page 118)

surface of one part at a time. While still wet, distribute the coat evenly over the surface with a pad about 3 in. square, folded from a full width of cheesecloth. There should be no delay between the application of the material by the brush and its distribution by the pad. Slight irregularity in the stain coat is desirable. All rounded edges and the higher projections of the turned parts may be rubbed after the stain has set to make them a trifle lighter than the body of the piece. Clean the brush in lacquer thinner, if you have any.

After allowing this coat to dry 30 minutes, the second or seal coat (from can No. 2) should be applied. It will be noted that the first coat in drying has changed to a paler color than when first applied, but it will return to about the original color with the application of the second and third coats.

Coat No. 2 is applied, like coat No. 1, with a fresh brush fully charged with the liquid. When coated, a second clean pad like the first is used in distributing the material. Take special care on the turnings to wipe the finishing material around with deft strokes so that all parts are thinly coated. The wiping with the pad, however, should not be repeated as a thin coating is all that is to be accomplished at this stage. Clean the brush with turpentine. Allow the work to dry for 24 hours.

AGAIN using a clean brush, apply the gloss coat from can No. 3 evenly over the entire piece. This is to be done with the brush only. Use a full brush, which will enable you to coat all parts evenly. Once the top, a leg, or any other part has been gone over, it should be left untouched, because repeated brushing will result in the piling up of the finish. Sufficient material should be applied to cover easily, but avoid drips or runs. Clean the brush in denatured alcohol.

After allowing this coat to dry for 45 minutes, take No. 000 steel wool and make a wad easily held in the fingers. With this, rub lightly over the whole piece. Hold the table between yourself and the source of light so as to watch the surfaces as they gradually become beautifully smooth. Avoid heavy pressure on the steel wool at all times; and throughout the entire finishing process always work with the grain.

This method will result in a velvety, soft gloss. To many tastes, no further finishing is desirable, but it is an improvement to do a little extra padding on the edges of the piece, the corners that have been rounded, and the high spots on the turnings. Taking the remainder of coat No. 3, reduce it by adding an equal amount of denatured alcohol. Now moisten a fresh, small pad on one side with this solution and brush lightly over the parts just mentioned. Avoid going over the same spot or part successively, as this will make the surface lose rather than gain luster.

A still deeper finish can be obtained, if desired, by applying and rubbing down a second full-strength brush coat before the final padding is given with the diluted mixture.

To obtain one of these kits, fill in the coupon on page 118. The number of kits is limited and it may not be possible to repeat the offer at this price, so do not delay. If you prefer Construction Kit No. 1 for making the maple butterfly table described last month (P.S.M., Jan. '31 p. 76), check it on the coupon. Or you may order both kits for $12.80.

Every kit is sold with an absolute money-back guarantee; if you are dissatisfied, you may return the kit within ten days, provided the parts have not been marked or damaged in any way, and your money will be refunded without question.

TAKING FLASHLIGHT PHOTOGRAPHS

(Continued from page 82)

except a sheet of cardboard or a plate on which to place them, the fuse being, of course, lighted by a match. They cost 90 cents a half-dozen.

Photoflash bulbs look like an ordinary 100-watt electric light bulb except for the crumpled aluminum foil that fills the round portion of the bulb. They are set off by electric current at a voltage from 1½ to 125, so they can be fired either by a flashlight battery or by the electric light current. If you have electric lights in the house, no special apparatus is needed to use them. You can screw one into a droplight socket with a piece of tin for a reflector and make the exposure by turning on the current. It usually is more convenient, however, to purchase one of the special dry-cell-operated photoflash bulb lamps that cost from a dollar up. The illustration at the head of this article shows a photoflash bulb being screwed into one of these special lamps. Each photoflash bulb is good for just one exposure. After it has been used, it must be discarded like any other burned-out electric light bulb.

THESE bulbs, when first introduced, cost 40 cents apiece, but the price has since dropped to 25 cents, and most dealers sell them at less than that in quantities of half a dozen or more.

Considered on a basis of the photographic effectiveness of the light produced, there is no choice between these various materials. An equally good flashlight picture can be taken with any of them.

Figuring on cost per exposure, the photoflash bulb is by far the most expensive. Of the magnesium preparations, the flash cartridge costs the most per picture, the flash sheet comes next, and flash powder is the least expensive of all by a rather wide margin.

On the basis of compactness and portability, flash powder also heads the list, with flash sheets a close second and the photoflash bulbs coming third. Even six of the bulbs make a sizable package.

If you neglect the question of cost and bulkiness, the photoflash lamp is far and away the best in every other quality that is important to the flashlight photographer. It makes absolutely no noise. It produces absolutely no smoke or dust. There is no fire risk whatever. And what is of even greater importance in taking pictures of children, the flash is so quick that it will not frighten even the most sensitive youngster. Indeed, experienced photographers accustomed to the glaring flash of the ordinary magnesium preparation have to convince themselves by trial exposures that the apparently insignificant flicker of light from the photoflash bulb actually will do the job.

THE problem of judging the exposure, always an uncertain factor in daylight work, is completely absent in flashlight work just as it is in using any other artificial light. You can be sure that every exposure you make will be successful if you are careful to keep your conditions the same each time. With the photoflash bulb, the light intensity varies as the square of the distance from the light to the object, as it does with any other artificial light inclosed in a cup-shaped reflector.

This rule does not, however, hold good in the case of flash powder fired in the open pan of a flash gun. In such a case a considerable portion of the effective light that reaches the object being pictured is reflected from the walls and ceiling so that a change in distance does not make quite so much difference. On the other hand, the color of the walls and the ceiling and the size of the room become correspondingly more important. If you find, for example, that a certain amount of flash powder gives the correct exposure with white walls and ceilings, more powder would be required for a similar picture in a bigger room with dark walls and ceilings.

All flashlight material except photoflash bulbs are extremely sensitive to moisture—particularly flash powder. When flash powder absorbs moisture, which it will do in half an hour if you leave the cork out on a damp day, it becomes lumpy. As my friend discovered at considerable expense to himself, lumpy flash powder is dangerous and unfit for use.

Several curious and amusing photographic stunts will be described in Mr. Ryder's next article, which will be the tenth in this series. Any questions you may wish to ask about flashlight photography or any other photographic problems should be addressed to Mr. Ryder in care of this magazine. Inclose a self-addressed, stamped envelope for his reply. If you wish a picture criticized, send the negative with the print; both will be returned.

$10 *for the best* FLASHLIGHT PHOTO

Popular Science Monthly will pay $10 for the most photographically perfect picture taken by flashlight and submitted on or before March 1, 1932. The only condition is that it must be taken during the months of January and February, 1932, by an amateur. Any type of camera may be used, and the developing and printing may be done by a professional. Mail both print and negative to the Photographic Editor not later than March 1, and mark your entry "February Photo Contest." If you wish the print and negative returned, send a self-addressed, stamped envelope with your entry.

Winner of Fifth Contest

Norman R. Hoyt, Taneycomo, Mo. has been awarded the $10 prize for the best picture in the photographic contest announced in the fifth article in the series (P. S. M., Oct. '31, p. 78). Those entrants winning honorable mention are as follows: J. V. Clohessy, Brooklyn, N. Y.; Wilton Fisher, Tulsa, Okla.; Harrison N. Mucher, Reading, Pa.; Lloyd L. Reise, Des Moines, Iowa; Charles F. Steiger, Allenwood, Pa.; J. M. Stofan, Garfield, N. J.; Lloyd Thompson, Lawrence, Kans.; Robert Dean Tompkins, Peekskill, N. Y.; Frank Wilding, Cheltenham, Pa.; and R. Wood, Edmonton, Alta., Canada. The winner of the November, 1931, contest will be announced next month.

TYPE CASES SERVE AS HARDWARE DRAWERS

PRINTER'S type cases, either new or secondhand, make satisfactory drawers for small drills, reamers, and other tools, and also for screws, nuts, and cotter pins,

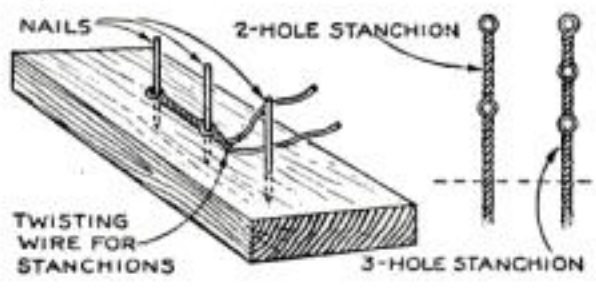
A cabinet with drawers made of printer's cases

or anything to be kept sorted in sizes. The cases can be purchased from almost any printers' supply house at a small cost, and they can be had divided in a variety of different ways. The cabinet I made for my own use has space for eight of the drawers, two each of four different kinds, and is fitted with two doors hinged to the sides.—C. B. MACARTHUR.

PREPARING STANCHIONS FOR A SHIP MODEL

IN BUILDING a model of the U. S. destroyer *Preston* (POPULAR SCIENCE MONTHLY Blueprints Nos. 125, 126, and 127, listed on page 107), I devised a simple way of making the stanchions for the rails that saved time and effort.

First I laid out the size and the spacing on a board and set headless nails into



Each stanchion is formed by twisting wire around a form and then dipping it in solder

the wood, as shown. A loop of wire was placed around the first nail and twisted until the twisted part extended to the second nail. The wires were then taken around that nail and twisted until the third nail was reached (in the case of three-hole stanchions), after which the twisting process was continued until the correct length had been obtained.

The twisted wire was then removed from the nails, straightened, and dipped into molten solder. When it had cooled, the surplus was removed and the holes redrilled.—J. A. L

BRUTAL BULLY AND TIMID SOUL

(Continued from page 42)

DR. POFFENBERGER: That is essentially true, but it is more complex than that. You see, sex is not the only thing that enters into our modern forms of wooing. Vanity plays a part in it; the desire to please; a sense of beauty, and other factors.

MR. MOK: What happens when our drives and urges are not turned to good account?

DR. POFFENBERGER: Let us stick for a moment to the urge to self-assertion, because it is responsible for so many of our problems. When education (and by this I mean all training, from earliest childhood) does not succeed in directing it into useful channels, there is sure to be trouble. In children, it may show itself in temper tantrums. In grown people, you may get cases of common bullies, criminals, and chronic invalidism.

MR. MOK: Invalidism?

DR. POFFENBERGER: Yes, this is a form in which the misdirected urge to self-assertion sometimes expresses itself. It is one method by which a person may force the attentions of others upon himself. As for criminals, the modern gang leader and racketeer are striking examples of the urge to self-assertion gone wrong. Arnold Rothstein, the notorious gambler who was shot, and Al Capone have clearly shown characteristics of leadership that have gone astray. Rothstein might have become a prominent banker, and Al Capone a great general or an industrial or political organizer, if their talents had been directed into different channels.

MR. MOK: What happens when the sex urge is not directed into useful channels?

DR. POFFENBERGER: You then get cases of dissatisfaction and restlessness, such as you see in its simplest form in the infant whose arms are held. At its worst, this may show itself in abnormal behavior unacceptable under our conventions. Often, it expresses itself in a revulsion against sex. This is the basis of prudery in people, and of exaggerated censorship.

MR. MOK: Is this what is meant by repression?

DR. POFFENBERGER: Repression is interference with these natural urges by social conventions which are called taboos.

MR. MOK: Would you say, then, that all taboos are bad?

DR. POFFENBERGER: Far from it. In order that people may live together in a society, the individual must sacrifice something of his freedom for the general good. Just how much he should be restricted is a great social question that has never been answered. It has differed in various societies through history, and it still differs decidedly in various countries, and even in various social groups within one country.

MR. MOK: What is the difference between repression and inhibition?

DR. POFFENBERGER: If there is any difference at all, it is this: Repression is a check on our urges and drives from the outside; usually, it is a check on our behavior. Inhibition is a check we exercise ourselves from the inside, and more on the urges themselves, before they express themselves in our behavior.

MR. MOK: And what is a complex?

DR. POFFENBERGER: That is a state of mind growing out of constant repression.

MR. MOK: Is it a normal state of mind?

DR. POFFENBERGER: Oh, no. The normal state results not from repression but from sublimation which, as I have explained, is the translation, as it were, of our urges and drives into desires for useful and acceptable activity. A complex that is serious enough to require treatment is "resolved," as we say, by the process of sublimation.

MR. MOK: What do you mean and how is that done?

DR. POFFENBERGER: Let us suppose that a person suffers from a complex resulting from repression of the sex urge. As I have told you, this may manifest itself in a variety of ways; it may go so far as to turn the person into a nervous wreck. The treatment then would consist in sublimating the patient's repressed sex urge into such acceptable activities as art, social service, or anything useful that is pleasing and satisfying to the patient. Great skill is required to bring about such a transfer, and it can be done only by an experienced practitioner who in addition to that is also a profound student of human nature.

MR. MOK: Is this what is known as psychoanalysis?

DR. POFFENBERGER: It is. Speaking of complexes, I told you in the beginning of our talk that an inferiority complex is the result of interference with a person's urge to self-assertion. Do you understand now that I meant it was the result of repression of the urge to self-assertion?

MR. MOK: I do. You have explained that all normal people have the urge to self-assertion. How does it happen to be repressed in some and not in others?

DR. POFFENBERGER: Training in the early years of life has much to do with it. Practically every young child at some time or other adopts an unsatisfactory method of giving expression to drives that have been thwarted. A very common case is the child with temper tantrums. The child, urged, for example, to eat a certain food, throws itself on the floor in a fit of anger, kicks and screams. Something must be done about that.

MR. MOK: What do you recommend to inexperienced parents?

DR. POFFENBERGER: A good, old-fashioned spanking is one method of dealing with it. Another is to ignore the child's antics completely. If something like that is not done, you may have the beginning of an abnormal method of meeting the problems and obstacles of life. The child then has found a weapon with which to force satisfaction of his urges. Now, the trouble is that, later in life, that weapon does not work, and the individual is unable to meet the ordinary situations. Result: inferiority complex which may show itself in any one of the different ways I have mentioned.

MR. MOK: You mean that all cases of inferiority complex arise from improper handling of the child in early life? If that is so, why isn't there more of it in the world or why don't we all suffer from it?

DR. POFFENBERGER: Your question requires a double answer. First, there probably is more of it in the world than you suspect. Secondly, we are not perfectly sure that some people are not born with a predisposition toward inferiority. It is virtually impossible to determine this definitely. But we do know that a baby only a few hours old learns that to cry will bring the satisfaction of being held and fondled. This may be the beginning of a wrong way of going about satisfying drives and urges. If you indulge it, you simply teach the child to get off on the wrong foot, and you may lay the foundation for an inferiority complex which later on, as you know, may prove a serious handicap to the individual.

RIDING THE WIND

(Continued from page 30)

accidentally made a double exposure. The result showed by Moth crossing the finish line with the two planes crashing behind it. But, the most remarkable shot of a racing crash I ever saw was taken at Trenton, N. J., last year. It showed one speed plane zooming upward, its steel propeller having sheared the tail of another machine completely away, while the injured craft, which crashed an instant later, was still on a level keel with fragments of its shattered tail-surfaces flying in all directions.

During a race, I glance around every few seconds to be sure I know the position of the other planes. This enables me to dive or climb on a turn without fear of crashing into an unseen ship in the maneuver. The old-time zoom that used to end air races has been abolished in the interests of safety. A winner would pull back the stick and shoot skyward to kill his speed when he crossed the finish line.

Now, pilots are required to keep straight on until they are away from the course before they go into a zoom. This prevents collisions with other ships pressing close behind the leader and flying above him. It is also against the rules to dive under a plane in the race for the finish line. A passing pilot must go to one side.

THE main reason racing planes fly low in circling a pylon course is to enable the pilots to judge the position of these turning towers accurately. A pilot, flying high, might easily cut a corner, and be disqualified, without realizing it. Skimming the ground, he is sure that he banks around the outside of every marker. At Hendon, in a race before the war, I once saw a pilot going a hundred miles an hour on a Deperdussin monoplane round a turn so low one wing tip scraped the ground, like the runner of a sled, sending up a trail of yellow dust. Yet the ship straightened out without a crash.

An even more miraculous escape by a low-flying speed pilot took place at Cleveland during the second lap of the recent Thompson Trophy Race. Crouched low in his bulletlike Laird Solution biplane, Dale "Red" Jackson rounded a turn at 230 miles an hour. On the first lap, he told me later, he had noticed a big tree to the right of the course. As he came out of the turn on the second lap, he looked for the tree. It wasn't there. Then he saw it, dead ahead. He pulled back the stick—too late. The landing gear and a lower wing of the plane, going nearly four miles a minute, tore through the upper branches, ripping the fabric to ribbons. Instead of landing, Jackson kept on, racing at the heels of the leaders. Eight times the spectators saw him rocket past the grandstands, torn fabric flapping madly from one wing, as he drove his crippled plane eighty miles to capture third place with an average speed of 211 miles an hour!

AN OLD adage of the racing hangars is: "Turns win the race." Hitting a happy medium between turning too sharp and too wide is the pilot's problem. The sharper the turn, the greater the loss of speed; the wider the turn the greater the loss of distance.

A mistake that beginners often make is waiting too long before going into the bank. As a result, they shoot far beyond the pylon before they can bring the ship around. Instead of flying on a direct line between turns, I fly out a little, beginning my turns early so I pass the pylon at about the center of my curve.

Banking too much is another source of trouble in pylon rounding. Often pilots who go into spectacular, (Continued on page 124)

RIDING THE WIND

(Continued from page 123)

vertical banks around the towers end by turning so far they have to bank back the other way to get in line with the next pylon.

Probably the worst mistake a pilot can make in a turn is to shoot around in such a tight turn that the plane "mushes down" violently through the air, centrifugal force driving it out away from the pylon. In effect, the ship makes a fast side slip with the whole area of the wings and tail opposing the sidewise movement. This is like applying a powerful brake and instantly cuts down forward momentum. Because a racing ship has small wings that support a heavy load, the stalling speed is high and there is an ever-present risk of slowing down below the danger point in making too sharp a turn.

A trick that veterans often use to overcome this danger is a fast climbing turn around the pylon. The path of the machine is like a quarter turn of a screw thread rather than a quarter section of a ring. By shooting up and around, instead of making the turn on a level, the plane actually travels a greater distance, thus decreasing the intensity of the centrifugal force while at the same time hugging close to the pylon. You climb on the turns and dive afterwards. While the ship loses a little speed on the climb, it gains it back on the dive. Of course, the climbing turn can be used only when the machines in a race are strung out and not bunched together.

IN CROSS-COUNTRY racing, I have noticed a curious thing. After an hour or so of skimming over trees and farms at tremendous speed, I seem to be going slower and slower. This illusion increases the danger of landing a racing ship. When a pilot has flown at 180 or 200 miles an hour for some time, it is almost impossible for him to slow down to eighty miles an hour, the landing speed, without tremendous concentration. He seems to be hardly moving and imagines he is stalling. So, at the end of a high-speed race, I purposely circle around at a moderate pace several times before coming down. This helps me judge my pace correctly and keeps me from touching the ground at a terrific clip. In a forced landing in a high-speed ship, the pilot should depend upon his air-speed indicator rather than his senses to tell him how fast he is flying when approaching the ground.

A few years ago, in England, I made a landing in this way in a Martinsyde racer with a 300-horsepower Puma motor. One hundred and twenty miles from the start of a cross-country race, a metal layer of the steel propeller split. The ship shook violently while the cracked blade screeched and whistled. I knocked off the switch and, judging my speed by the indicator, came down for an eighty-mile-an-hour dead-stick landing in a plowed field.

ANOTHER time, the strangest propeller accident I ever heard of forced me down in a light-plane race near Lympne, on the British coast. I had entered a tiny, eighteen-foot plane with a motorcycle motor that swung a thin, four-foot wooden propeller at tremendous speed. We were racing on a ten-mile course. The backstretch lay along the top of a 600-foot ridge of hills.

On the fourth lap, a squall broke over the ridge. Sheets of water poured down, pounding the wings of the little plane as it smashed through the downpour. When we came out, I felt the motor slowing down. I shot a glance at the instruments. The oil and gas pressure was O. K. Yet the pull of the motor grew weaker and weaker. Tiny garden plots were spread out below me, but none of them were big enough for an emergency landing.

Losing power every second, I headed for the Lympne field. The little ship cleared the boundary hedge with hardly a yard to spare. When I examined the propeller, I found why the pull of the motor had gradually died. The leading edges of the blades were completely chewed away. The rain, striking the light wooden blades as they whirled at 3,600 revolutions a minute, had eaten away the entering edges.

The queerest case on record of a forced landing in a race occurred in England in the early days. A pilot well known for crazy behavior spent months tuning up a second-hand machine for a contest. Then, as he was near the lead of the race, he passed over Epsom Downs, scene of the famous horse-race classic. Two pretty girls waved at him as he went by. He turned around and landed for a little talk and when he crossed the finish line, the race was over and the crowds had gone home!

Often in a cross-country race, pilots fly machines having exactly the same speeds. Then, the winner is the one who steers the straightest course and is most skillful in riding the wind. Above 3,000 feet, there are few east winds, the strongest breezes being from the west. So, if a pilot is flying east in a race, he should fly high; if going west, low.

LINDBERGH took full advantage of westerly winds, by flying at a height of nearly two miles, when he broke the transcontinental record a few years ago in his Lockheed monoplane. All record-setting dashes from coast to coast are made from the Pacific to the Atlantic so the planes will fly with a tail wind.

Another innovation in transcontinental racing was introduced by Lindbergh's flight. Instead of making the run non-stop, he broke it up with a descent at Wichita, Kans., for fuel. This stop actually increased his average speed instead of cutting it down. When a plane is carrying a huge load of fuel, such as is required for a 3,000-mile flight, it moves through the air with wings tilted at a big angle in order to support the weight. But when the load is lighter, the wings are at a flatter angle and the speed is higher. When Jimmy Doolittle raced from coast to coast recently in eleven hours and sixteen minutes, he stopped three times for fuel, once at Albuquerque, N. M., once at Kansas City, Mo., and once at Cleveland, Ohio.

Before a cross-country race, I always study the clouds carefully. When high clouds are moving rapidly and low ones slowly, I know the upper winds are strong and the lower ones light. Then I fly high or low according to which way I am going, high if going with the wind, low if going against it. In distance racing, watch the winds. Use them every chance you get.

WHEN it pays to climb above the clouds to get a tail wind, you have to use care in navigating so as not to get off the course. As racing ships fly at tremendous speed, even a slight error in compass flying will carry them miles off the course in a few minutes.

The time compass flying helped me most was during the King's Cup Race in 1924. I was flying a 350-horsepower Jaguar-Siskin. Its top speed was 150 miles an hour. At Hendon, I was flagged away tenth. In the race up the east coast of England to Newcastle, I passed two planes and landed eighth. Across the Cheviot Hills and the Scotch mountains to Glasgow, I edged up to fifth place by hugging *(Continued on page 125)*

RIDING THE WIND

(Continued from page 124)

the windward slope of the ridges.

This is a familiar trick in cross-country racing. You gain speed by avoiding the sheltered side of ridges. When the wind strikes a ridge at right angles, it deflects upward into strong rising currents such as gliders use for soaring. Flying through these upcurrents in a racing plane, the pilot can point down the nose of his machine at an angle, adding power of gravity to the pull of the motor to increase his speed, and still not lose altitude. The rising air lifts the plane as much as the angle carries it down. Once, in a race along the sand dunes of the French coast, I added fifteen miles an hour to my speed in this way.

Near Manchester, the third stop, I began to have trouble with the fourteen-cylinder engine. Something had slipped in the carburetor, giving the cylinders a greater proportion of air than gas. The rules of the contest forbade adjustments at the control points. So, out of Manchester, I climbed to 13,000 feet. Here, the rarefied atmosphere cut down the proportion of air to gas and the motor functioned perfectly. While the other planes wound through the mist-filled passes of the Welsh mountains, I, by necessity, raced at full throttle on a compass course for Bristol, high above the clouds. For a hundred miles, I was out of sight of land, steering by the instruments and estimating the side wind-drift by guess. Thirty miles from where I thought the next stop was located, I started coming down, traveling like a bat with the engine wide open. Plunging through the heavy clouds, I burst out of the floating fog right above the Bristol Channel, not three miles from the airport!

In one hop, I had jumped from fifth place to first. At the end of the dash to Hendon, I crossed the finish line at the head of the procession. An ailing carburetor had won the race!

An ideal contest for modern planes, which I expect to see someday, would be a 15,000-mile aerial marathon, circling the borders of the United States. As a free-for-all battle, it should be open to every type of machine. Pilots should be allowed to fly as many hours a day as they wish with the prize to be awarded to the first man to finish the circuit.

Such a test of stamina and speed would bring out weak points in present-day aircraft and navigation. This is the greatest benefit that comes from racing. Speed classics of the past have aided materially in the development of stronger planes, better motors and finer fuels.

WATCH for Capt. Courtney's next article. It will give you inside information on inventions the aircraft industry is looking for. It will list the common errors of those designing airplane improvements. It will contain practical, helpful advice of value to anyone working on an aircraft idea or interested in flying. Don't miss this outstanding article by an internationally-famous test pilot and designing engineer. Be sure to order your March copy of POPULAR SCIENCE MONTHLY *in advance. On the newsstands February 2nd.*

STEER BY SEA'S FLOOR

TRANSATLANTIC steamships will be guided to North American ports by the ocean bottom. Submerged landmarks as distinctive as those above water have been charted by the U. S. Coast and Geodetic Survey. By keeping one eye on his contour map of the bottom and the other on the readings of his depth meter, a ship's captain can readily steer his course.

A definite program for getting ahead financially will be found on page four of this issue.

CRIME SECRETS READ ON BULLETS

(Continued from page 36)

occurred a few years ago in an eastern city. Because of the unusual setting of the crime, it formed headline news throughout the country.

In mid-afternoon, on the main street of the city, an undertaker was mysteriously murdered at his place of business. The only clue to the slayer was a .32 caliber shell lying on the floor beside the body. Robbery was eliminated as a motive, as the cash register was untouched. No one had heard a shot.

It was believed the unknown assassin had entered the establishment, fired the fatal shot, and made good his escape when the noise and excitement of a political parade, passing the door, was at its height. The dead man had no known enemies. It seemed likely that "unsolved" would be the final notation after the case on the police records.

TWO weeks passed without a clue. Then detectives raided the rooms of a man suspected of running a gambling house. In his private desk, the officers found sheaves of newspaper clippings all relating to the baffling "Mortician's Murder Mystery." The man was closely questioned. He admitted owning a .32 automatic and readily turned it over to the police.

When a ballistics expert compared the markings left by the barrel of this weapon with those on the fatal slug, he saw the pattern of the scratches was entirely different. But, *the markings left on the empty cartridge by the breechblock were identical with those on the base of the shell picked up at the scene of the crime.* The scientific detective declared the chances were less than one in a million that any other gun in the world had figured in the murder.

Then, a young sleuth, who had been investigating the recent activities of the suspected man, uncovered an interesting fact that proved the statement by the expert was right. On the day after the killing, the gambler had sent a rush order for supply parts for his automatic, including a new barrel. Knowing the skill of firearms experts in tracing down the weapon used in a murder, he had substituted a new barrel after the slaying so the markings his gun made on lead would differ from those on the fatal bullet. However, he overlooked the fact that a gun leaves its "fingerprint" upon cartridge shells as well as bullets.

The confession of the killer revealed that, unknown to his family, the undertaker had incurred heavy gambling debts and then had repudiated them. The gambler had gone to collect the money on the day of the crime. In the argument, he had fired a single, fatal shot. The blare of horns and the shouting of the crowd outside the funeral parlor had drowned out the sound of the automatic. He had then slipped away unnoticed and after substituting a new barrel on his gun, thought himself safe. But microscopic valleys and infinitesimal islands on the base of the fatal cartridge, which his weapon had ejected at the time it was fired, betrayed him.

EVERY time a gun is shot, the explosion that drives the bullet forward jams the cartridge shell back against the breechblock with equal force. In some cases this recoil is as great as 10,000 pounds to the square inch. The metal of the cartridge base is softer than the steel of the breechblock, so every irregularity of the steel surface is imprinted indelibly upon it, just as an impression is stamped into soft wax. As the breechblocks are finished in the factory by filing, and as, under the microscope, no two file marks are identical, each block stamps on the cartridge a signature that can't be forged.

Not only does the breechblock leave its telltale imprint, but the ejector, which throws out shells in an automatic, and the extractor, which pulls them out in a revolver, also leave markings on the softer metal of the shells that frequently aid the firearms sleuth. Again, the circular craters left by the firing pin tell their story.

In the mountains of West Virginia, a few years ago, a young man was arrested for the murder of an aged trapper. He had been seen near the old man's cabin on the day of the slaying and a shotgun shell, similar to the kind he used, was picked up in a patch of weeds near by. Col. Goddard was called to examine the suspect's gun and the empty shell.

The firing pin, he found, made a peculiarly-shaped dent in every shell, and that identical dent was in the metal base of the shotgun shell, picked up near the scene of the crime. To prove his case, Col. Goddard told me, he sent to the factory where the suspect's gun was manufactured and obtained half a dozen firing pins made on the same machine one after another.

PICTURES, taken of them through a powerful microscope, showed that the six pins had as different characteristics as six faces. Minute variations, invisible to the naked eye, made each firing pin distinctive. Col. Goddard's evidence resulted in a verdict of guilty after five minutes of deliberation by the jury.

Recently, a parlor toy of the '90's, the stereoscope, has been employed by the firearms expert to convict criminals. Dr. J. H. Mathews, Director of the Department of Chemistry at the University of Wisconsin and a noted scientific crime investigator, has developed a method for showing juries a true perspective image of firing pin marks on shells. By reproducing the photomicrographs on cards and inserting them in the stereoscope, he enables the jurors to see the enlargement exactly as they would if looking through the high-powered microscope in the expert's laboratory.

Often, the convicting evidence engraved on the metal base of a cartridge can be seen only when magnified a thousand times. Take the famous "War Hero Murder Case," in Montana.

The trapping of the killer, through clues so tiny that a microscope enlarging 1,700 times was needed to find them, was one of the many feats of firearms identification accomplished by Luke S. May, master scientific cleuth, of Seattle, Wash. A strong manila envelope, labeled "Case Number 767," in May's laboratory file, contains the details of this remarkable murder on a moving train.

SOME time on the morning of September 20, 1929, John Joseph Wright, a British war hero, was shot to death while riding on a freight train between Shelby and Great Falls, Mont. A unique feature of the case was the fact that no one knew at what point during the trip the killing had occurred. As the train passed through four counties on its run, four district attorneys appeared for the prosecution.

Thomas Grove, a thirty-five-year-old roustabout, was seen leaping from the train at Conrad. Sheriffs later picked him up as a suspect eleven miles from the town. In his coat pocket, they found an automatic firing the same caliber of cartridges as those found in the gondola freight car beside the bullet-riddled body of *(Continued on page 127)*

SECRETS OF CRIME READ ON BULLETS

(Continued from page 126)

the war hero. But there was no direct evidence that Grove had committed the crime.

Luke May first fired numerous shells through the suspect's automatic. Then he compared the markings of the firing pin and the breechblock under his powerful microscope with those on the fatal shells. Photomicrographs, magnifying the bases of the shells 1,700 times, showed no less than twenty-six distinctive marks, none more than a thousandth of an inch in size. This amazing, subvisible evidence broke down the arguments of the defense and convicted the guilty man.

How far away was the gun when a fatal bullet was fired? That is a question the firearms detective must often answer in reconstructing the action of a slaying.

FOR half a morning, I watched one noted expert making such tests in his laboratory. White squares of blotting paper were fitted into a frame at the mouth of a basket filled with waste. Holding the muzzle of a blue Colt automatic, which had figured in a gangster's death two days before, one inch, then two inches, then three inches, and so on, from the squares of blotting paper, he pulled the trigger. After each shot, he carefully marked the square and measured the diameter of the black ring of powder markings about the torn bullet hole. By comparing these diameters with that of the powder marks about the fatal wound, he told me, the position of the gun when it was fired can be determined almost to the inch.

One of the most recent discoveries in the realm of firearms enables a scientific Sherlock to trap elusive killers through invisible gas deposits in the pores of the skin. When a revolver cartridge explodes, the chemicals that make up the powder decompose and form large quantities of gases, mostly compounds of nitrogen. The back drift of these gases leaves deposits in the pores of the hand firing the gun.

TO DETERMINE whether a suspect has fired a revolver recently, the scientific sleuth spreads a layer of warm paraffin over his hand, including the index trigger finger and thumb joint. When the layer of paraffin is about a quarter of an inch thick and still warm, it is peeled off and set to cool. As soon as the cast is hard, the side that was next to the hand is treated with a chemical solution of di-phenyl amine in concentrated sulphuric acid, and then studied with a magnifying glass. If the nitrogen compounds were present in the pores, they passed into the paraffin and their contact with the solution results in the formation of telltale crystals of brilliant blue.

Forensic ballistics, the science of the firearms expert, is now a mainstay in solving crimes of violence. Only seven years ago, the Supreme Court of the state of Illinois handed down a decision to the effect that it was preposterous for any man to say he could trace a fatal bullet to the one gun from which it came. A few months ago, this same court completely reversed its stand and acknowledged that great value of forensic ballistics in solving mysterious murders.

THE next installment of this great series will tell the thrilling story of how fingerprints undo criminals, and the latest tricks adopted by the underworld to fool the experts. Read of the feats of bloodhounds of the law who track down wanted men with dusting powders and magnifying glasses. Watch for it in the March POPULAR SCIENCE MONTHLY. *On sale February 2nd.*

STONE-AGE SURGEONS HAD MODERN SKILL

(Continued from page 23)

a skull taken from an Inca tomb near Cuzco in which one of the teeth contained a lump of pure silver, hammered into a cavity that showed evidence of decay. Whether the decay followed the ornamental filling, or the silver was hammered in after decay had started, no one can say.

Superstition, of course, was strangely mixed with primitive science in the surgical work of these peoples, and is so mixed today in the work of the physicians of all the tribes of Mexico and South America. Bone flakes, cut from the skull or other parts of the body in trephining and other bone surgery, were saved, perforated, and worn as amulets by the patient. Inlaid teeth have been found strung as necklaces, presumably worn by the relatives of one who died, even though his operation were a success. To halt rheumatism in the fingers, their ends were frequently removed at the first joint, and the resulting bone worn as a charm, probably against the rheumatic pains. These things are not far removed from the potato in the pocket, or the lump of assafoetida around the neck, which many civilized men and women still carry in the belief that they will ward off disease.

THE Incas and the Mayas used toothbrushes, and the Tepehuanes and Tarahumares still do so. I have been informed by reliable men that the Sioux and the Pueblo Indians also use them. These brushes were made out of the dried roots of the anise and other aromatic plants, which were pounded until they offered bushy, fibrous ends for this use.

The stone-age Seri Indians, of Tiburon Island, in the Gulf of California, treat stomach and bowel pains with hot, flat stones, wrapped in deerskin and placed on the affected parts. Also they massage the abdomen with large round stones, in the same manner in which the Blackfeet are recorded as using balls of wood. Evidences have been found among the Incas and Chibchas of what is believed to have been comparable with modern "tapping"; that is, the opening of the abdomen to relieve pains due to overeating. When one of the tribe breaks a bone, the Seri medicine man finds the fracture with his fingers, sets the break, and holds it in place with a splint made of cat-tail, or *tule*, stalks. Yet this tribe is the lowest in civilization of all New World Indians, with the possible exception of the Tierra del Fuegans, at the lower end of South America.

Turning from surgery to internal medicine, I have found, in some ten years' study of primitive medical and surgical work, that the Indians of North and South America had for centuries, and still use, more than one hundred wild plants as remedies for various ills. It must be remembered, in considering this subject, that probably the Indian had no epidemic diseases until he met the white man. In other words, all of the medicine man's practice was individual, mainly concerned with external injuries due to accidents of the chase or to fighting, and to disorders of the intestinal tract brought on by gorging in times of plentiful food supply. For rheumatic pains, he had the *temoscal*, or sweat house, comparable with our steam baths and common to virtually all the Indian tribes of both Americas. Coupled with this, he used massage, and soaked the joints and bones in a hot infusion of wild balsam leaves.

For stomach pains, one of the main remedies was a liquid made by steeping wild buckwheat leaves and stems in hot water for three or four days. From the white flowers of *(Continued on page 129)*

A definite program for getting ahead financially will be found on page four of this issue

A definite program for getting ahead financially will be found on page four of this issue

STONE-AGE SURGEONS HAD MODERN SKILL

(Continued from page 128)

the same plant, the Cahuillas made a wash for the eyes. Wild wormwood made another remedy for intestinal pains, and greasewood, boiled with hot stones in a clay pot, furnished a powerful purgative for all the desert-dwelling tribes within its range.

TODAY, one of our most important remedies for coughs, colds, and inflammations of the throat and lungs is the inhalation of a vapor carrying creosote. When the white man arrived in the New World, the Indian medicine men were using infusions of the creosote bush for the same purpose. They also inhaled, in their sweat houses, the vapor from boiling creosote leaves. Early white physicians of the American deserts borrowed this remedy from the Indians, as they did many others. Leaves of the sumac, boiled into a tea and drunk in quantities, furnished another continent-wide remedy for colds.

Mistletoe, the magic parasite plant of the Druids and still closely connected with our Christmas celebrations, was dried and pounded into a fine powder for use on open sores of men and animals. It has healed galls on burden-bearing dogs, guanacos, vicunas, and horses from its northernmost range to what is now Argentina, in South America, and is still in use for these purposes by white men as well as Indians.

From the Haida of British Columbia to the Aymaras of Peru, Indian medicine men use as anesthetics cocaine from the coca plant, strong infusions of the well-known Jimson weed (datura), and hypnotism. Wild tobacco, dried, finely ground, and mixed with lime, was used both as a remedy for toothache and as a chewing mixture analagous to the betel-nut habit of Melanesia and southeastern Asia. It also was smoked and made into cigarettes. Snuff was made for the tribe by the medicine man from the berry of a wild acacia. Chewing gum came from the dried sap of a milkweed, called "chil-se" by the Cahuillas and other southwestern tribes.

TEA, somewhat similar to our own but more bitter, is made by virtually all the desert-dwelling tribes, from an almost leafless gray-green plant, Ephedra nevadensis, which grows from central California to southern Chile, wherever there are desert areas. An infusion of these stems formed the spring tonic, or blood purifier of these Indians, much as sulphur and molasses did with us. The liquid made by boiling oak bark in water for several days was used as a skin hardener and an astringent, at about the time that our white ancestors in Europe were finding out that this liquid formed an excellent tanning fluid for leather.

Rather well-made crutches have been found in the cliff dwellings of North America and among the tombs of the more advanced tribes in South America. There is evidence that human hair was used in the sewing up of large wounds and in the binding of bandages around small abrasions. Spinal wrenches and twists were incased in corsets made of bark, molded to the figure and bound into the desired shape with thongs of rawhide. This is analagous to the head-shaping of infants by some of the tribes, and goes back to the origin of primitive medicine and surgery in the ancient effort to drive out the demons held to be responsible for all illness. From that beginning, however, the true physician and surgeon among primitive tribes grew away from the magic-working priest until he became possessed of a profession as particular, in its degree of advancement, as is that of the modern white man of medicine.

A definite program for getting ahead financially will be found on page four of this issue

CREWLESS GHOST FLEET

(Continued from page 25)

manned warship, however brave, could risk, competent authorities predict that a Ghost Fleet may introduce revolutionary tactics in naval engagements. Radio-controlled men-of-war could be sent to ram and sink enemy vessels, or, loaded with high explosives, they could scud alongside them like animated torpedoes, and be blown up at the touch of a radio key. Smoke screens could be laid by a Ghost Fleet, hiding the movements of the main body as it maneuvered into a strategic position. Poison gas could as easily be released. Without endangering human lives, mine fields could be swept by the crewless vessels.

Individually they could be sent to the mouth of a harbor and sunk by radio to block a channel with their hulks; collectively they could be dispatched as a tactical feinting force to deceive a distant enemy. They might be controlled from land, from other vessels, or from airplanes droning high overhead.

Whether or not such considerations have interested other powers, the United States is not alone in developing radio-controlled ships. Great Britain as early as 1924 fitted the battleship *Agamemnon* for distant control, and officials watched it zigzag, unhit, through an explosive hail of 114 aircraft bombs dropped from heights of one to two miles. Now the Admiralty has replaced it with the crewless battleship *Centurion*, controlled from a destroyer.

GERMANY'S pride, the radio-controlled battleship *Zaehringen*, showed off its paces in a demonstration a few weeks ago. Under radio guidance it fired rockets, hid itself in a smoke screen, and dodged a hail of shells. Views of the thrilling spectacle are reproduced here, through the courtesy of the Ufa film organization, which coöperated with the German navy in photographing the show.

Japan has fitted its small destroyer *Ukuzi* as a ghost ship, and used it as a target for big guns.

But the United States is the pioneer of them all, for the new Ghost Fleet will be the culmination of twelve years' experiments. The world's first radio-controlled warship was the U. S. S. *Iowa*. In 1920 that ex-battleship was equipped by John Hays Hammond, Jr., noted radio expert, to run as a crewless vessel.

With no previous experience to go on, he carried out the extraordinary engineering feat with brilliant success. To make a ship run by radio control, its own power is used; radio impulses simply steer and govern it. The first step is to figure out the smallest crew that could run the ship's engines and operate its steering and other controls effectively. Then the task is to devise mechanical robots to take the place of each man of this skeleton crew. There will be a mechanical helmsman at the rudder, actually a system of levers that takes the place of a human arm; and similar mechanical automaton engineers to work the steam valves. Individual electric motors are the muscles of these robots.

SINCE it is still impossible to transmit enough energy to run a motor by radio, the signal from a distant vessel is amplified, and operates a relay that starts the motor under power from the phantom ship's own plant. Actually the radio signals are coded, so that a selector similar to those of dial telephone centrals determines whether the impulse is to operate the steering motor, stop the ship, or turn on the searchlight.

Such a ship was the one that Hammond rigged up. Its effectiveness as a training target was proved when Army and Navy planes from 4,000 feet scored only two hits out of eighty, *(Continued on page 131)*

CREWLESS GHOST FLEET

(Continued from page 130)

while the vessel steamed toward shore at the relatively slow speed of six and a half knots. Eventually the *Iowa* was sunk off Panama by the warship *Mississippi's* gunfire.

It is a long way from the *Iowa's* plodding gait to the thirty-four-mile-an-hour speed at which the *Stoddert* recently cut the water off San Clemente Island, Calif. The Naval Research Laboratory at Bellevue, D. C., helped design the improved system; so did Lieut. Commander Boyd R. Alexander, radio design officer at the Navy's Bureau of Engineering. On completion of his tour of duty there, he was ordered to fit the *Stoddert* as a ghost ship and to command it.

With her officers and crew aboard, the Ghost Fleet's trial horse came steaming out from her anchorage at the southern end of San Clemente Island and met her control ship, the destroyer *Perry*. The *Stoddert's* crew made preliminary machinery adjustments, stopped the ship, ran up its warning signals, and transferred to the *Perry*. On the latter's bridge, an enlisted man stood facing a small black metal box with a lettered keyboard. This was the control radio transmitter.

An order, "one third ahead," was given the operator; he pushed one of the keys, and the *Stoddert*, 500 yards distant, started moving through the water.

ANOTHER key was pressed and the *Stoddert* increased her speed. Gradually, by use of the signal keys on the *Perry*, the ghost ship was worked up to full speed. The crewless craft left a white, swirling path of foam astern as she dashed headlong on her arrowlike course at thirty-four miles an hour.

She was sent around San Clemente, turning to her new course at the will of the buttonlike keys on the *Perry's* bridge. She was made to lay a smoke screen; to stop; to start again; to turn off her lights; to blow her siren; to sheer off suddenly as if to dodge a torpedo; to turn 180 degrees, and then to straighten on a new course.

At times, the *Perry* was close to the *Stoddert;* at other moments, she was five or six miles away. When the trials were concluded, the ghost ship was stopped. Her crew, returning aboard, found her machinery functioning normally. And spectators saw in her performance a hint of the greater wonder, the Ghost Fleet that is to come.

SECRET FORMULA INK DRIES INSTANTLY

THERE is no more common occurrence in a business office, probably, than a man hunting frantically for an illusive blotter and finding it only after the signature has already dried. The chemist for a British Columbia mining company has evolved a secret formula for the production of an ink that dries instantaneously, is proof against ordinary acids and commercial ink eradicators, remains unaffected by freezing, and does not evaporate as rapidly as other inks.

It is especially useful in fountain pens, as its chemical and dye ingredients are developed to remain in constant suspension so they will not corrode or gum the barrel. Satisfactory dyes have been found for only blue ink and the red that is in such constant use these days.

With it one can write on any sort of paper and run a finger over the script immediately afterward without the least smearing. Even on glazed paper, it takes less than three seconds for it to dry completely.

It can be made and sold for about twenty percent more than ordinary ink. On coarse-grained paper it will not spread and make a blotch.

IS THE IRON HORSE DOOMED?

(Continued from page 21)

tion, signal bridges are being torn down, and higher ones are being erected to allow room for these wires.

Stationary transformer stations are being erected along the route at distances of from seven to ten miles apart. These stations, each with a continuous capacity of 18,000 kilowatts, will feed alternating current to the conductor wire at a voltage of 11,000, stepping it down to this value from the 132,000 volts of the transmission line.

Like ordinary householders, except on an incomparably larger scale, the railroad expects to purchase from electric generating companies the current needed to run its trains. To get an idea of the tremendous amount of current that will have to be bought, it is sufficient to know that each of the 150 locomotives will consume as much current in an hour's run as the average home user would consume, for lighting, electric irons, vacuum cleaners, and so on, in five years!

TO UNDERSTAND the advantages of electric operation of steam railroads, comparisons with steam must be made at many points.

The first electrification projects in this country, begun as early as 1895, recognized three of the advantages of which in later years wide use has been made. The electric train was quiet and smokeless. It was capable of being started, accelerated to full speed, and stopped in a small fraction of the time required by a steam-operated train. This latter was particularly true of multiple-unit trains—or trains made up of cars having individual motors, all under a common control.

Today, quiet, smokeless, and rapid terminal service is performed by electricity in most of the great cities of the world. Electric locomotive and multiple-unit service has invaded the congested suburban districts of cities as far separated as New York, London, and Sydney, Australia. The electric suburban service of the Long Island Railroad transports 85,000,000 passengers a year. With only 365 miles of the 422,000 miles of track in the United States, it carries twelve passengers out of every hundred carried by all the class one railroads!

As locomotives and transmission systems were improved, it became evident that electric locomotives could be built with power at least as great as achieved by the heaviest steam locomotives, and that because of additional inherent characteristics the electric locomotive was capable of better meeting the fluctuating and rigorous duty required in pulling heavy trains over steep grades.

STEAM or electric, every locomotive must have sufficient power to pull its train over the steepest grade on its route. Having little overload ability, the steam locomotive's power must often be largely in excess of the power required for the greater part of the run. As electric locomotives, however, are merely *transformers of energy*, and not self-contained units of power, these locomotives may be designed with a rating more in proportion to the power required for the average part of the run, and still be able to more than double, or even *triple*, this rating for short times.

Electric locomotives are better than steam for going up grades, and also for descending them. On down grades, the motors may be made to perform as generators, feeding current back to the power line, and at the same time giving a powerful braking effect to the train.

A number of railroads, including the Chicago, Milwaukee and St. Paul, the Great Northern, the Norfolk and Western, and the Virginian have electrified their mountain divisions, and by virtue of the electrification have distinctly improved their service.

The Virginian Railway, which performs almost the exclusive service of hauling coal from the mining district in the vicinity of Mullens, W. Va., over the mountains to Norfolk, offers a striking example of what electric power can do. This railway has long been noted for the operation of long trains of tremendous tonnage, and the use of powerful locomotives of the Mallet 2-10—10-2 class.

Until the electrification of the most difficult part of its road, in 1925, the Virginian had hauled 5,500-ton trains from Elmore to Clark's Gap with the straining assistance of three of the most powerful steam locomotives used anywhere in the world—a Mallet 2-8—8-2 engine pulling and two Mallet 2-10—10-2 engines pushing These three locomotives had a total of fifty-six driving wheels, and weighed together 1,270 tons! With great effort, they could move the train up the steep grade at a maximum speed of six or seven miles an hour.

AFTER electrification, the trains were loaded to *6,000* tons, and were hauled smoothly over the same track at the rate of fourteen miles an hour with but a single electric locomotive at each end! With but twelve of the new locomotives, the Virginian discovered that it could perform with greater expediency the work that had previously required forty-eight of its giant steam locomotives!

The electric locomotives which do this work are 152 feet long, and represent the largest and most powerful locomotives, either steam or electric, in the world.

Although electric locomotives cost on an average about twice as much per unit as steam locomotives of equal power, the number of units required to handle a given traffic is so much lower that the total cost for a given installation comes out about the same.

Due to the time taken for building and extinguishing fires, turning at terminals, cleaning fire boxes, cleaning boiler tubes, and general overhauling, steam locomotives spend only about half of their hours on the road. Electric locomotives can show an average of over ninety percent of their time in actual service.

THROUGH the years of trial, with apparatus which, in many cases, was almost experimental, the electric locomotive can show records of remarkable endurance. At the vast Oak Point freight classification yard of the New York, New Haven and Hartford, which has a main line electrification system next largest to the Pennsylvania, switching locomotives have often shown records of twenty-four-hour service a day for thirty days at a stretch. And the regular freight and passenger locomotives of the Chicago, Milwaukee and St. Paul run half a million miles without need of serious overhauling!

Sometimes dozens of steam locomotives stand idle in a single yard, steam up, waiting to be called into service; coal being burned. Electric engines have no such stand-by losses.

Other advantages, such as flexibility, the possibility of doubling the track capacity, operation in either direction, simpler operation, and operation from the front end, make it clear that from a purely technical standpoint there is no reason why electricity should not supplant steam on every main line in the country. *(Continued on page 133)*

IS THE IRON HORSE DOOMED?

(Continued from page 132)

Here, however, the matter of cost steps in. Although the final operation and maintenance of an electric road may be considerably cheaper than that of a steam road hauling similar traffic, the roadside equipment requires a large initial outlay. If the traffic over the road is not sufficiently heavy, or if there is not some other saving condition such as cheap electricity from water power, the original outlay might take far too many years to pay for itself. It is on the long single- and double-tracked lines, with little grade and through sparsely settled areas, that the Iron Horse, for the present at least, is comparatively safe.

In twenty-nine countries, electric giants now race along rails once ruled entirely by steam. With heavy grades and a meager supply of coal, but with abundant water power, it is not surprising to learn that in the percentage of electrified to steam-operated railroad, Switzerland leads the world. Fully eighty-five percent of the ton-miles of its trains is today hauled by electricity.

However, if the vast scheme proposed to the British House of Commons by Lord Weir's committee on railroad electrification should be accepted, the leadership would turn to Great Britain. According to this proposal all the main line track in Great Britain would be changed over to electric operation. The project would give continuous employment to 60,000 men for fifteen years, and would cost $2,000,000,000.

HOW TO SET UP YOUR LABORATORY

(Continued from page 69)

gram or ten grams of iron, the proportions being two to one by weight.

In pouring powders of chemicals into the balance pan, place a sheet of paper on each pan, and with the mouth of the bottle over the pan, rotate the bottle, holding its bottom upward at an angle sufficient to cause the substance to flow from the bottle in a gentle stream.

Many substances and chemicals used in your experiments will be found about the house or shop. Zinc can be obtained from dry cells, copper from wire. Epsom salts is magnesium sulphate; baking soda, sodium bicarbonate; alum, potassium aluminum sulphate. These substances should be bottled and labeled as such. Chemical handbooks and formula and recipe books give many other synonyms.

In experimenting, one should not taste chemicals. Care should be taken in handling acids. Concentrated sulphuric and nitric acids are the most dangerous. If acids are spilled on the skin or clothing, deluge the spot with water. A rubber apron will help protect your clothes, in performing chemical experiments.

THIS series on chemistry for the home laboratory will be continued as a regular monthly feature, conducted by Mr. Wailes. In March, practical experiments of interest and profit will be presented by him and he will be glad to receive any suggestions you care to make or to answer any questions you care to ask him.

"EYE" TURNS ON LIGHTS

ECONOMICAL of current is a show window device invented in Germany, for it illuminates the window only when a spectator's shadow, falling upon an electric eye, operates a switch that turns on the lights.

FROGS BY THE MILLION

(Continued from page 55)

eating little and that little only what they can gather on the bottom, to which, of course, chopped meat and oatmeal are dropped at frequent intervals.

When the late spring and summer sun attracts them from this winter's rest, they have become six or seven inches long, three times their autumn size.

The mouth then loses its oval shape and becomes wider, the gills are absorbed, the front legs or arms are pushed through, and the lungs begin pumping in oxygen through the mouth and nostrils. The tail shrinks and is absorbed as food into the body, since the tadpole eats nothing during this month or so of transition. If the tadpoles have been properly and well fed, virtually 100 percent of them become frogs; if not, a large proportion dies. The little frogs, each about two inches long, appear on the banks by thousands, safe from the other frogs and from the large water beetles but in prime condition to attract all the raccoons, cats, rats, ducks, wading birds, and snakes that can reach the ponds.

"HERE comes the real hard work of the frog farmer's year," Herriman explained, "for all these thousands of little frogs, quick as brown-green flashes and hungry as little wolves after a hard winter, must be caught and transferred to the fenced pond, where they can be protected from all their enemies. The only way to catch them is with a dip net, and I expect to have at least twenty men, and myself, working hard for three or four days transferring these million or more tadpoles into the larger pool.

"And those voracious appetites must be satisfied, if the frogs are to grow. Bullfrogs eat only living food. In these first stages, when the frogs are small, insects, such as flies and gnats, must be attracted to the rim of the pond. To do this we place stale meat, fish-heads, and sometimes bits of bread smeared with molasses along the bank, just at the edge of the water. Around these fly-baits, the young frogs congregate, feeding on the insect life. The speed of an adolescent frog is as great as that of a striking snake. The tongue is fastened at the front of the mouth and can be thrown out with lightning-like rapidity to seize an insect."

This final transformation of the tadpole into the frog-form takes place about eleven months after hatching, depending on climate, time of arrival of summer, heat of the sun, and character and quantity of food fed to the tadpoles. After about a month of the insect diet, the young frogs, growing rapidly, add minnows, young crayfish, and small green frogs *(Rana pretiosa)* to its insect bill of fare. All their food is swallowed whole.

Herriman's quarter of a century of study of the bullfrog leads him to believe that each of these anurans in the wild state requires about one acre of marsh and pond to provide it with food. That is to say, ten bullfrogs, producing about 100,000 eggs a year, would live well, without artificial feeding, on a ten-acre swamp tract. But a million frogs, in a five-acre swamp-pond, for example, must be fed.

"To provide food for them," said Herriman, "we have found top (surface) minnows the stand-by. I stocked my ponds with several thousand of these minnows last July, and today there are uncounted hundreds of thousands of them. They reproduce themselves faster than the frogs, the ducks, and the wading birds can eat them.

"The bullfrogs jump at insects up to two inches in length, such as dragon flies, when the latter are several inches above the water. To catch the surface minnow, the frog selects a hiding place among the stalks of the cattails or other vegetation where the minnows feed. There he sinks himself (or herself) until the wide mouth is even with the surface. As the unsuspecting minnow swims along on top of the water looking for food, the frog snaps it into its two-inch mouth, moving nothing but its jaws. Then the frog merely continues to sit still until the next minnow arrives. These top minnows also have another value, as their principal food is the eggs and larvae of mosquitoes. Thus, they rid the frog and tadpole ponds of these pests."

Crayfish holes, well banked up, dot the banks of the open ponds. The adult crayfish, six or seven inches long, is in no danger from the bullfrog; but when the young, which are hatched from eggs carried under the tail of the female crayfish, take to the water, the bullfrog adds them to his menu.

"I imported about 1,000 of these crayfish from Louisiana and Oregon," said Herriman. "Now, after six months, I estimate that I have a stock of probably fifty times that number. These have to be fed with scrap foods of all kinds, and make excellent scavengers for the ponds.

"When the young crayfish leave their mothers, shown by the sudden muddying of the water around the edges of the pond, they are picked up by th usands in dip nets and thrown into the pond containing the large frogs. Arrowheads, sometimes called 'duck potatoes,' or just 'duck weed,' seems to be the best aquatic plant for the crayfish pools."

Little green frogs also increase rapidly, each female laying about 2,500 eggs each summer, and occupy the ponds naturally, without planting. The transformation of the tadpole of this frog takes place in a little less than a year, and they furnish an abundant and timely natural food for the bullfrogs.

Number, size, and arrangement of ponds depend on local conditions, quantity of available water, and general lay of the land. Where the water does not freeze in the winter, eighteen inches is an abundant depth for all the ponds. Where the winters are more severe than in California deeper water is required, so that the frogs may hibernate in the mud at the bottom.

In the breeding ponds, Herriman allows 1,000 square feet of water surface for each pair of bullfrogs. In the concentration ponds, where the frogs are collected just prior to marketing, one square foot is allotted to each pair. Green frogs, where they are reared extensively as food for the bullfrogs, require 100 square feet of water surface for each pair in the breeding ponds.

NEW YORK CITY consumes about 30,000,000 pairs of frog legs a year; San Francisco some 8,000,000; Chicago around 18,000,000, and Los Angeles 3,000,000.

Greatest demand and highest price is for the frog that weighs about one pound. For this reason, Herriman sells his frogs when they weigh from one to one and one half pounds. Food and water to produce a frog of this size cost approximately five cents a pound. Labor adds another cent. Interest on investment, cost of ponds, and so on, vary with locality, proximity to cities, and other similar factors, but the total cost is less than ten cents a pound.

In preparing the frogs for market, the heads and entrails are removed and the body left in its own skin, which has been found to be the best wrapper for the meat. No use has been found for the skins, but experiments are being conducted as to their value for shoes and purses.

GUS TELLS HOW TO SAVE GAS

(Continued from page 74)

"You can drive much better than I can."

"I wasn't kidding," Gus grunted. "If you think you know the ins and outs of gas economy, Jack, tell me some of 'em!"

"Why, er, you just coast all you can, of course." Norcross paused. "And that's about all there is to it," he finished lamely.

Gus shook his head sadly.

"We'll have to send you to the foot of the class," he observed. "Why, coasting is only one little item. In the first place, you've got to have your carburetor adjusted for the most economical running, and that isn't the way most carburetors are set. Then there's a whole list of little things that, taken together, make a lot of difference. There mustn't be any drag in the brakes. You want to keep your tires pumped at all times to five pounds more pressure than regular. If you don't think tire pressure makes any difference in the rolling friction, just try pushing the car with the tires five pounds below pressure and then with them five pounds over.

"OF COURSE the condition of the engine itself is mighty important. A reasonable amount of carbon doesn't make any difference, but leaky valves do, and leaky piston rings are still worse."

Norcross was deeply interested. "How do you tell when you've got the carburetor right?" he inquired.

"When you have each adjustment shut down to the lowest point that will give satisfactory running," Gus explained. "Gasoline and air will explode evenly in the cylinders in many different proportions, ranging all the way from a thick mixture rich in gasoline to a thin mixture with several percent less gas. When driving along on a level road you can't tell which mixture you have.

"A carburetor set for a thin mixture will show up when you start the motor in cold weather. You'll have to use the choke a bit longer to make up for the lack of gas in the mixture. When you strike a hill, the thin mixture will make the motor seem not so peppy. On the other hand, the thin mixture has a tendency to burn away the carbon in the cylinders, and the spark plugs stay clean longer.

"Now about driving so as to get good gas mileage," Gus continued. "You mentioned coasting. That helps, of course. It helps, too, to use the brakes as little as possible. Quick starts in traffic waste gas. The speed you drive at is important. You'll have to find by experimenting just what average speed will give you the most miles per gallon. And you have to take the wind into consideration to figure driving speed.

"SUPPOSE you find that thirty miles an hour is the most economical speed on the average. If you were driving into a head wind of thirty miles an hour and your speedometer also shows thirty miles an hour, your speed through the air is sixty miles, and the most economical speed would be a lot less than thirty. On the other hand, if you have a stiff tail wind as you did today, the easiest speed on the gas supply might be forty or even fifty miles an hour."

"Gosh!" Norcross exclaimed. "I'd have to have two brains to remember those things."

"You don't remember them," Gus grunted; "you make a habit of driving economically if you really want gas mileage. If you want something to remember, try remembering always to stop at the pump that sells the premium grade gas. Filling the tank with good gas is one trick that is sure to help you get plenty of mileage."

Skippers Trained on School Ships

(Continued from page 19)

ship business. They are learning that the sum of their careers is calculated to make the American merchant marine foremost in the world. They are learning it in daily contact with real men who have tasted adventure in the raw.

There was a time when candidates were accepted as cadets who had no more than a grammer school education; then the requirements were raised to two years of high school, but beginning in February, 1932, all candidates must have had the equivalent of four years in high school, the same as for Annapolis and West Point. The reason for this is mathematics.

A ship's officer uses spherical trigonometry in navigation and he has need of arithmetic, algebra, and geometry every day of his life, in calculating weights and volumes of cargo in relation to space available for storage on board ship and in preserving a ship's equilibrium. When a ship rolls its center of buoyancy is constantly shifting in relation to its center of gravity. The safety of a ship is absolutely dependent on her officers' understanding of such matters and that knowledge is applied every time cargo is stowed in a ship. The *Vestris* case shows what may happen if mistakes are made.

THE cadets have plenty of experience in the actual handling of cargo, but they learn about the technical problems of cargo stowage and the stability of ships in regular schoolrooms with blackboards aboard the *Empire State* and the *Guilford Pendleton*, now called the Annex. This is a sturdy old schooner, the dormitory of the upper classmen.

It is linked with the *Empire State* by gangways. Its masts have been removed and portions of the hull are covered with blackboards. Facing the blackboards are rows of desks like those used in public schools. The problems worked out on the blackboard have much more meaning for the students than any problem they ever had in their previous school experience. The old timbers of the schooner are a sort of monitor, warning by their creaking that on the sea authority and mathematics go hand in hand.

Blackboards are not enough for Captain Tomb. He had plans for getting a variety of ship models and a tank in which to float them. The students will then work their problems in cargo stowage on these, loading models with tiny bales and boxes and little pigs of metal to discover for themselves the consequences of being wrong in such matters. It would take several days to load a real ship; they will be able to stow cargo and discharge it from one of the models in a few minutes. In the thirty-two hours they devote to the subject in the two semesters of their first year, they deal with every possible kind of problem.

THIRTY-TWO hours for cargo stowage just gives them the flavor of their education. A graduate has had not less than 320 solid hours of instruction in navigation. Models won't serve here. Skull practice is the thing that counts and when they go to sea they work the ship. Every day of their cruise they are given hours of navigation work. Each day at 8:30 a. m., noon, and 4 p.m. all deck cadets, sextants in hand, take sights for position. Indeed, that sea routine is eloquent in showing how they learn their jobs.

At sea from 8:15 p.m. to 6:45 a.m. two watches are below sleeping while the third watch is on duty. Consequently at 8:15 p.m. a bugle sounds "lights out." The rule is "silence, fore and aft." At 11:45 p.m. the mid-watch is called for duty from midnight until four in the morning. Then the routine is: 12, midnight, muster the watches and relieve the watch; 3:45 a.m., call the morning watch; 4 a.m., muster the watches and relieve the watch; 4:15 a.m., turn to; scrub and wash clothes; 5 a.m., clean paintwork and wash down the deck; 6:45 a.m., up all hammocks; 7:30 a.m., breakfast for the two watches below; 8 a.m., muster all hands except engineers of 4—8 and 8—12 watches; breakfast for 4—8 watch; 8:30 a.m., sick call. All deck cadets take a.m. time sight.

At 9:15 a.m they knock off all work. Just a good, old fashioned vacation for fifteen minutes during which all they have to do is to be sure that their quarters are ready for inspection at 9:30 a.m., immediately after which there follow two hours of instruction in seamanship and navigation.

AT 11:30 a.m. comes the welcome retreat from study with dinner for the 12 to 4 watch; and at noon, there is dinner with the watches below with the simultaneous mustering of the watch on deck.

At 12:30 all deck cadets take sight for latitude as clocks are set for local apparent noon to come at 12:30 by ship's time. At 1:00 p.m. "mast for reports and requests"; 1:30 to 2:30 p.m. signal drill; 2:30 more navigation work until 4:00 p.m., when the watches are mustered following which there is more scrubbing and washing clothes and nothing else to do until 5:30 p.m. when the watches below get supper. Six o'clock is supper time for the 4—8 watch. At 6:30 p.m. the watches are mustered and relieved. At 8 p.m. all hands are mustered except the engineers of the 4—8 and 8—12 watches; the watch is relieved and then, fifteen minutes later the call "lights out" is sounded.

There is a day of twenty-four hours. Pile those on top of each other for three and a half months in each of two successive years and you will find yourself either a competent young mate—or else an ex-cadet. Certainly little time is wasted.

WHEN these young fellows go ashore in some foreign land, they know how they got there. They know the world is round. They know a whole lot about the mechanism of the universe, the wheeling of the stars and sun and the ceaseless march of that which men call time; they have, in fact, begun to develop a philosophy. After the first few weeks of such a life they cease to be just boys and are metamorphosed into men. Beyond question, the upper classmen could, if the need arose, take charge of the *Empire State* and cruise with her around the world. They learn to give commands as well as take them.

In this connection it should be said that there is no hazing in this academy. Captain Tomb will not tolerate it; but none knows better than he that there should be constant recognition of the superiority that at sea goes with authority, and so he has instituted a system of class rates which keep the lower classmen in their place and at the same time make them long for the day when *they* will be upper classmen. Under classmen in this academy always address upper classmen as Mister and Sir; and they may not speak to these lordlings at all except on ship's duty. The fourth classmen (the freshmen) are not "plebes" as at Annapolis. Here they are "boots." Boots are permitted to smoke only on the Annex or in the yard and not on the *Empire State* except on cruise.

There are certain youths, a minority, who entering this school, find they are so fond of machinery that they scorn the chance that leads to masters' tickets and seek instead to learn those things that a chief engineer must know. Captain Tomb has a notion that not enough of those who seek admission fully appreciate the advantages of being educated as a marine engineer. A marine engineer can always find a good job ashore. He is capable of running any kind of power plant.

On the *Empire State* the cadet engineers devote those hours that their fellows of the deck give to navigation to the task of learning how power is generated and used.

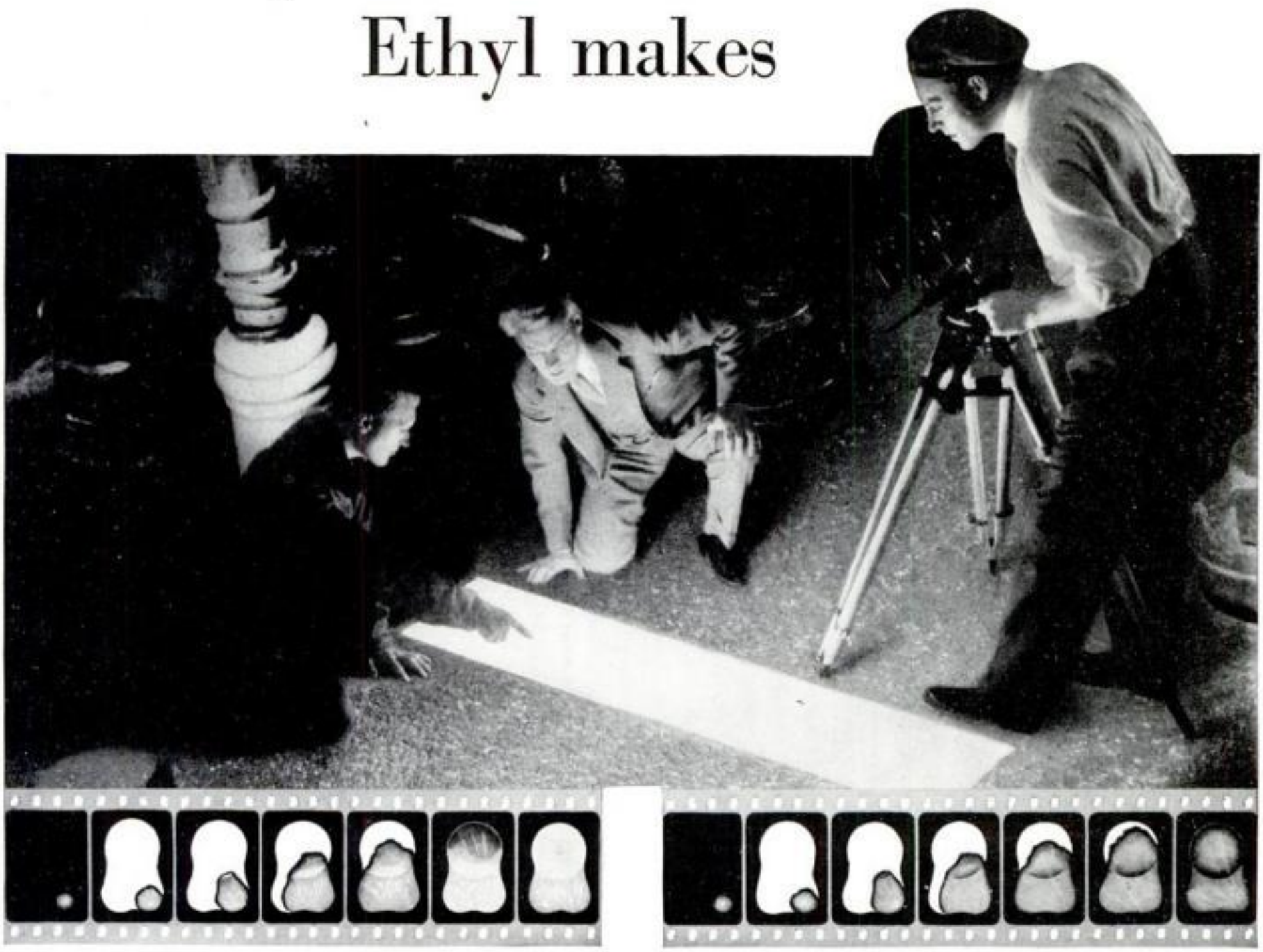
IN THEIR two years at the academy they get a technical education such as is available in only a few other schools in the country; and when they go to sea in the *Empire State* every cylinder and piston, every crank and bolt is a familiar thing.

New York boys who become cadets pay $160 to cover the cost of their clothing and books during the two years; boys who are residents of other states pay in addition to this charge $750 a year for board and tuition and the payments are accepted in three installments. All the other costs are borne by the state and the Federal Government.

About the end of May this year, the lines that hold the *Empire State* fast to a dock in the Brooklyn Navy Yard will be cast off and the school, with its 120 cadets, will start off for the annual cruise of three and a half months in European waters. Every graduate has had the benefit of two of these cruises, which usually include visits to London, Paris, Rome, and other European cities.

At present the state of New York is negotiating with the national Government for a permanent home for this school on the fifty-six acres and buildings of Fort Schuyler not long since abandoned as a military post.

Now you can *SEE* the difference Ethyl makes



ORDINARY GASOLINE is in the cylinder. You see the spark in the picture at the left. In the next the gasoline vapor starts to burn. More—more—more burns. Then suddenly, in the sixth picture—BANG! The remaining gasoline explodes. That is KNOCK. The last picture shows nothing but afterglow. Knock wasted the gasoline that should be working now.

ETHYL GASOLINE starts from the spark in the same way—as shown in the first three pictures. But Ethyl can burn at only one speed: *the right speed*. See how its flame spreads *evenly* from start to finish. It is not all burned until the last picture—delivering its greatest power when the piston is going down—when power counts most in the performance of your car.

ETHYL
BRAND OF ANTI-KNOCK COMPOUND
ETHYL GASOLINE CORPORATION
NEW YORK, U.S.A.
Controls Combustion

GOOD GASOLINE + ETHYL FLUID = ETHYL GASOLINE

Ethyl fluid contains lead

YOU could always *feel* the difference with Ethyl Gasoline in your car. Now you can *see* the difference.

Engineers in General Motors' Research Laboratories, by fitting a quartz window in the cylinder head of a modern high-compression motor, took photographs of the actual combustion of motor fuels.

The photographs show that ordinary gasoline burns *unevenly*. The last part of the charge explodes violently, wastefully—causing harmful knock, overheating, and loss of power. The same photographs prove that the power of Ethyl Gasoline is delivered with a smoothly increasing pressure that brings out the *best* performance of *any* motor.

Seeing is believing. Look at the pictures above and you will understand why car manufacturers now offer high compression engines as either standard or optional equipment—to take full advantage of Ethyl and its almost universal distribution by oil companies today.

The Ethyl emblem on a pump is your assurance of value in motor fuel. Its quality on every count is maintained by constant inspection of samples collected daily in all parts of the country. Ethyl Gasoline Corporation, New York City.

Buy ETHYL GASOLINE

"I have to be kind to my throat"

"I've tried several brands of cigarettes but I prefer Luckies. I smoke them regularly as I have to be kind to my throat. I learned this from my previous stage experience. **Your improved Cellophane wrapper is splendid. A flip of the tab and it's open."**

Kay Francis

MOISTURE-PROOF CELLOPHANE
Sealed Tight Ever Right
THE UNIQUE HUMIDOR PACKAGE
Zip—
and it's open!

When **Kay Francis** left the stage and enlisted in the Hollywood army, pictures got a great recruit! The tall brunette beauty was a great success on her film debut, and she's charged along to even bigger things. She is one of **Warner Bros.'** brightest stars.

"It's toasted"

Your Throat Protection — against irritation — against cough

And Moisture-Proof Cellophane Keeps that "Toasted" Flavor Ever Fresh

★ Is Miss Francis' Statement Paid For?

You may be interested in knowing that not one cent was paid to Miss Francis to make the above statement. Miss Francis has been a smoker of LUCKY STRIKE cigarettes for 5 years. We hope the publicity herewith given will be as beneficial to her and to Warner Bros., her producers, as her endorsement of LUCKIES is to you and to us.